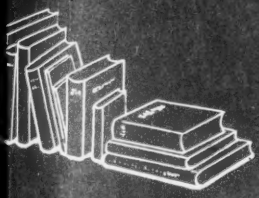
ABSTRACTS OF NORTH AMERICAN GEOLOGY



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ABSTRACTS OF NORTH AMERICAN GEOLOGY

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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by W. O. Addicott, J. P. Albers, Calvin S. Bromfield, R. A. Cadigan, Georgianna D. Conant, J. J. Connor, H. R. Cornwall, Claire B. Davidson, R. C. Douglas, S. E. Frezon, Andrew Griscom, B. C. Hearn, J. J. Hemley, Virginia M. Jussen, Marie L. Lindberg, R. A. Loney, Elisabeth S. Loud, S. H. Mamay, E. K. Maughan, Mildred C. Mead, J. F. Mello, M. Natarajan, Virginia S. Neuschel, A. E. Roberts, E. H. Roseboom, S. P. Schweinfurth, J. C. Vedder, Dorothy B. Vitaliano, H. C. Wagner, and W. S. White.

ABSTRACTS

Adams, John A. S. *See* Rogers, John J. W. 6938

Adams, Samuel S. *See* Linn, Kurt O. 6921

7179 **Adams, Samuel S.** Some geochemical observations on evaporites [abs.]: Mining Eng., v. 18, no. 1, p. 44, 1966.

6644 **Addicott, W. O.** Late Pleistocene marine paleoecology and zoogeography in central California: U.S. Geol. Survey Prof. Paper 523–C, p. C1–C21, illus., tables, 1966.

Late Pleistocene open-coast assemblages from the Santa Cruz–Point Ano Nuevo area of central California include 101 larger invertebrate taxa. Nearly all of these are illustrated. Modern bathymetric ranges of the large molluscan component suggest water depths of 15–20 fathoms at the site of deposition. Zoogeographic criteria suggest late Pleistocene average winter surface water temperatures of about 7.5°C, about 4° cooler than today. Inferred average summer temperatures were about 13°C, about 2° cooler than today. Associated foraminiferal and ostracode assemblages suggest comparably cool marine hydroclimate. Late Pleistocene molluscan assemblages from the central California–Oregon area have modern geographic ranges that overlap in the vicinity of southern British Columbia. These cool water faunal assemblages are included in the newly recognized Nuevan molluscan province.—W.O.A.

Alder, B. *See* Oeschger, Hans. 6754

6848 **Alger, R. P.; Crain, E. R.** Defining evaporite deposits with electric well logs, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 116–130, illus., table, 1966.

Many evaporite deposits can be located and defined through use of electrical logging tools developed for oil exploration. In evaporite exploration the primary interest is in the identification and definition of the matrix minerals. Because most evaporite minerals are extremely resistive, electrical resistivity measurements are used in a first reconnaissance. The less resistive beds of shale, sand, and carbonate may be eliminated from further study. Formation density measurements are used in most evaporite studies and some minerals are directly identified, but usually density must be complimented by other data. Comparisons of density and acoustic velocity identify salt, trona, anhydrite, and other evaporites; the neutron log, sensitive to water, helps define hydrous minerals; and gamma ray measurements help distinguish between various potassium salts.—G.D.C.

6747 **Allan, M. H.** Natural gas storage in caverns in Saskatchewan, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 412–421, illus., 1966.

At Melville, the 530-ft section of the Prairie Evaporite consists of a thin basal zone of anhydrite, overlying halite with some clay and minor bands of interbedded anhydrite. Over this, potassium bearing salts top at a depth of 3,400 feet. In the

lower part of the section a 290,000 bbl cavern was formed by solution mining. Water was obtained from, and brine disposed of in, the Blairmore Formation at a depth of 1,800 feet. The cavern has been operated "dry" with a minimum of problems. At Regina the Prairie Evaporite, at a depth of over 5,000 feet, required deeper drilling and high pressures, but two caverns are being alternately developed and used. At Prud'homme, where 450 feet of Prairie Evaporite lay at depths similar to those at Melville, glacial drift water substituted for an insufficient Blairmore supply, and a thick layer of anhydrite reduced the cavern height.—G.D.C.

Alldredge, Leroy R. *See* King, Elizabeth R. 6787

6949 **Allen, Clarence R.; Smith, Stewart W.** Parkfield earthquakes of June 27-29, 1966, Monterey and San Luis Obispo Counties, California—Preliminary report, pre-earthquake and post-earthquake surficial displacements: Seismol. Soc. America Bull., v. 56, no. 4, p. 966-967, 1966.

Small right-lateral surficial displacements had been recognized prior to the late June earthquakes in at least three places in the Parkfield-Cholame trace of the San Andreas fault. Similar creep, or slippage, continued after the earthquakes (about 7 mm per day between June 29 and July 8 at one place, intermittent displacements at others). Continuing fault displacements seem to be associated with individual after shocks in addition to uniform creep.—D.B.V.

Allen, Ralph O., Jr. *See* Reed, George W., Jr. 6856

Allen, Richard H. *See* Taney, Norman E. 6646

7181 **Altschuler, Zalman S.** Rare earths in phosphorites—Geochemistry and potential for recovery [abs.]: Mining Eng., v. 18, no. 8, p. 42, 1966.

6876 **Amadon, Dean.** Birds around the world—A geographic look at evolution and birds: Garden City, N. Y., Natural History Press, 175 p., illus., table, 1966.

In this book, a well-known ornithologist delves into the geologic past when the first birds were taking to the air; he examines the history of bird extinction and the continuing process of evolution and speciation. In the first chapter a geological timetable of birds is given; other chapters include the effect of physical barriers, ecological requirements, and patterns of distribution—present and past.—G.D.C.

Ames, H. T. *See* Kremp, G. O. W. 6872

7033 **Ames, L. L., Jr.** Cation exchange properties of wairakite and analcime: Am. Mineralogist, v. 51, nos. 5-6, p. 903-909, illus., table, 1966.

Exchange capacities of natural analcime and wairakite, and synthetic wairakite, calcium- and strontium-based analcimes are given. Strontium-based analcimes probably do not persist in nature because the distorted structure tends to revert to normal non-cubic sodium analcime in the presence of sodium ions. Data support conclusions of previous authors that natural calcium substitution for the sodium in analcime is limited.—B.C.H.

7151 **Amos, Dewey H.; Wolfe, Edward W.** Geologic map of the Little Cypress quadrangle, Kentucky-Illinois: U.S. Geol. Survey Geol. Quad. Map GQ-554, scale 1:24,000, sections, text, 1966.

Gravel and sand for road metal are obtained from continental deposits at several pits in the Little Cypress quadrangle. Minor occurrences of fluorite are present in outcrops and small prospect pits in rocks of the Chester Series along or near faults in the northeastern quarter. Clay in the McNairy Formation may have ceramic uses and limestone in several formations could be used for aggregate. In the southern half of the area Quaternary fluviatile deposits and the McNairy Formation contain large supplies of ground water.—M.C.M.

6850 **Andelfinger, George F.; Fiedelman, Howard W.** Properties of the impurities in Northern rock salt, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 365–368, illus., 1966.

Impurities from various grades of Northern rock salt [from Fairport Harbor mine, Ohio] were separated in unchanged form from their respective salt matrices. Chemical analysis shows the separated impurities to be principally calcium sulfate. Solubility characteristics of the isolated impurities were examined in saturated and one-half saturated sodium chloride brines. The effect of the following variables on the solubility was determined: time, temperature, pH, impurity particle size, and impurity to brine ratio. The possible significance of these data in relation to the quality of brine produced from rock salt is discussed.—Authors' abstract

6683 **Anderson, John Jerome.** Geology of northern Markagunt Plateau, Utah [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7256, 1966.

7059 **Anderson, Orson L.** Seismic parameter ϕ—Computation at very high pressure from laboratory data: Seismol. Soc. America Bull., v. 56, no. 3, p. 725–731, tables, 1966.

By using the accuracy inherent in ultrasonic velocity measurements taken at pressures less than 10 kb, the seismic parameter $\phi=(v_p)^2-4/3(v_s)^2$ can be computed at very high pressures. The equation used requires the assumption that the second derivative with respect to pressure of the bulk modulus be negligible at all pressures considered. This assumption is checked by computing the compression (V/V_o) in the pressure range by equations of state using the assumption, and comparing the resulting values with measured compression. Illustrations are given for MgO and Al_2O_3.—Author's abstract

6825 **Anderson, Raymond J.; Graf, Donald L.; Jones, Blair F.** Calcium and bromide contents of natural waters: Science, v. 153, no. 3744, p. 1637–1638, illus., table, 1966.

The linear relation observed in a log Ca^{++} versus log Br^- plot for subsurface Cl^- waters is attributed to ultrafiltration by shale of sea water and fresh water that have passed through sedimentary rocks since their formation. Reactions between these solutions and sedimentary minerals, particularly dolomitization, must have contributed additional Ca^{++} to solution.—Authors' abstract

Anderson, Roger Y. *See* McLeroy, Carol Ann. 6829

Antweiler, J. C. *See* Delevaux, M. H. 7082

6711 **Archambeau, C. B.; Flinn, E. A.; Lambert, D. G.** Detection, analysis, and interpretation of teleseismic signals—[Pt.] 1, Compressional phases from the Salmon event: Jour. Geophys. Research, v. 71, no. 14, p. 3483–3501, illus., 1966.

The P-wave radiation field is interpreted in terms of crust and mantle structure using data on the first- and later-arrival P-phases and their amplitude spectrums obtained from the Salmon nuclear event. A symmetric, purely compressive source is indicated. The essential features of the observed traveltimes and amplitudes are explained in terms of regional mantle structures characterized by low-velocity zones which terminate with rapid and continuous increases in velocity near depths of 130 km. The velocity structures also show a strong gradient near 130 km. The regional models differ most strongly in the relative extent and magnitude of the velocity decrease in the low-velocity zone.—D.B.V.

6889 **Armstrong, Richard Lee.** K-Ar dating using neutron activation for Ar analysis: Geochim. et Cosmochim. Acta, v. 30, no. 5, p. 565–600, illus., tables, 1966.

A new technique of argon analysis by neutron activation which has been perfected for use in K-Ar dating is described, and results of its application to 30 granitic plutons in eastern Nevada and western Utah are reported. The dates fall into two major groups of 13–64 m.y. and 93–182 m.y. All dated plutons east of the Antler orogenic belt are Oligocene and Miocene, synchronous with the major volcanism

in the region. For shallow plutons at least, the intrusive and volcanic time scales appear to coincide, but deeper plutons may be older than their K–Ar ages. There is no obvious association of age with chemical composition, association of ore deposits, petrography, or depth of emplacement.—D.B.V.

7219 **Arnold, K.** On the influence of gravity anomalies on satellite orbits, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 137–142, illus., 1966.

By examination of the perturbations in the orbital elements of near-Earth satellites, gravity anomalies are determined for large unsurveyed areas of the Earth's surface. These interpolated anomalies in conjunction with average anomalies over surveyed areas may be used to determine the potential field of the Earth.—Author's abstract

6927 **Arrhenius, Gustaf.** Sedimentary record of long-period phenomena, *in* Advances in Earth science—Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 155–174, illus., 1966.

The Earth's layered rocks not only represent time series but also reflect geophysical and chemical conditions at various time levels. Pelagic sediments in protected basins far from land are little diluted by continental debris and more faithfully record long-period phenomena in ocean, atmosphere, and outer space, especially in subpolar and equatorial organic productivity zones, where sedimentary layers representing discrete time periods thicken with an increasingly rich biotic component toward the Equator. In the manifestations of changing currents, variable rates of speed, alternating climates, and vertical mixing of water layers, the trade-wind-driven mechanism has been counteracted by a steady equatorial undercurrent of the same magnitude as that in the Gulf Stream. Atmospheric circulation is recorded by the distribution and crystal structure of continental dust minerals, and their chemistry such as concentration of barium.—G.D.C.

Austin, G. S. *See* Sloan, R. E. 6673

Austin, S. R. *See* King, J. W. 7186

6802 **Averitt, Paul.** Coal deposits of eastern Montana, *in* Montana Coal Resources Symposium, 1st, 1964, Proc., App. B: Montana Bur. Mines and Geology Spec. Pub. 36, p. 69–80, illus., tables, reprinted 1966; originally published 1962.

This paper was originally part of a report entitled "Mineral potential of eastern Montana—A basis for future growth" published as Senate Doc. 12, 89th Congress, 1st sess. Coal in eastern Montana occurs primarily in the Tongue River Member (Paleocene); thickness and number of coal beds, and rank of coal increase to the west as the Member thickens. In Big Horn and Powder River Counties as many as 20 beds are present, some of which are 40 feet thick. Beds exposed at the surface burn spontaneously, and clinkered outcrops are common. Data on thicker beds and beds in fields near transportation are summarized; a map and table show potential strip-mining localities.—E.S.L.

6746 **Baar, C. A.** Measurements of rock pressure and pillar loads in deep potash mines, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 18–33, illus., tables, 1966.

Rock bursts and other failures in German potash mines necessitated intensive study of salt rock reactions in mining including measurements of deformation in wall, roof and floor in boreholes, of absolute subsidences/uplifts after working a panel, of bolt loading, and of hydraulic pressures in bore-hole sections filled with oil and sealed. From results represented by graphs and tables it was concluded that in the use of rock salt any new opening under high triaxial stress removes one direction of stress and the resulting plastic flow into the opening indicates relaxation; depending on time, the extent of this flow is controlled by mechanical properties of the rocks and their original stress; subsequent low yield points allow only quasi-hydrostatic local stresses; uplift of strata below a panel is not efficiently impeded,

if competent roof strata delay subsidence; and sudden recovery of delayed subsidence may load pillars too fast.—G.D.C.

6849 **Baar, C. A.** Bromine investigations on Eastern Canada salt deposits, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 276–292, illus., tables, 1966.

For information on the possibilities of potassium deposits, the bromine contents have been determined in a series of rock salt samples from several sequences in the Upper Mississippian in eastern Canada. Samples from two sub-basins in Nova Scotia are very low in Br/Cl. The paleogeographical environment favored potassium deposition in deeper central areas of the two basins. Thick evaporites in the Cumberland basin extended throughout northern Nova Scotia from New Brunswick to Prince Edward Island. Potassium salts have been encountered in the former Malgash mine as well as in the Pugwash salt mine. Bromine contents of the Cumberland basin salt confirm high concentration of evaporated sea water. Nova Scotia's favorable geographic position would compensate an ore quality even far below the famous Saskatchewan potash.—*from* Author's abstract

Back, William. *See* Rubin, Meyer. 6716

Baerreis, David A. *See* Bender, Margaret M. 7009

Baker, James V. *See* McManus, Dean A. 6966

Baker, M. J. *See* Callow, W. J. 7014

6713 **Balchan, A. S.; Cowan, G. R.** Shock compression of two iron–silicon alloys to 2.7 megabars: Jour. Geophys. Research, v. 71, no. 14, p. 3577–3588, illus., tables, 1966.

The compressibility of two Fe–Si alloys (4.0 and 19.8 weight percent Si) has been measured to 2.7 Mb. The results are consistent with an outer core containing 14–20 percent Si in Fe, as proposed by Ringwood (1959) and by MacDonald and Knopoff (1958).—D.B.V.

6738 **Bannister, Bryant.** Dendrochronology and radiocarbon analysis [abs.], *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF–650652, p. 396 [1966?].

6993 **Barczak, V. J.** Schroeckingerite from Ambrosia Lake uranium district: Am. Mineralogist, v. 51, nos. 5–6, p. 929–930, 1966.

The presence of schroeckingerite at the Ambrosia Lake uranium deposits is confirmed by an X-ray diffraction analysis of newly collected specimens.—M.L.L.

6852 **Barnard, Ralph M.; Kistler, Robert B.** Stratigraphic and structural evolution of the Kramer sodium borate ore body, Boron, California, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 133–150, illus., 1966.

The Kramer ore body, a lenticular sedimentary facies of borax and kernite crystals with interstitial and interbedded claystone, has been divided into seven stratigraphic units. The sodium borate facies, successively enveloped by a ulexite facies, a colemanite facies, and a barren claystone facies, constitute the Shale member of the Kramer beds. The term Kramer beds locally designates all conformable Miocene strata beneath Quaternary alluvium down to the base of the Saddleback basalt member. The shallow lake in which the borax and mud were progressively deposited remained structurally low due to movement along a fault scarp at its south edge. The ore body has been deformed by faults and associated folds, some contemporaneous with borax deposition. Some borax altered to kernite after thick burial by fluvial sediments. With regional uplift and erosion, some of the kernite reverted to borax.—G.D.C.

7167 **Barnard, W. M.; Christopher, P. A.** Hydrothermal synthesis of chalcopyrite: Econ. Geology, v. 61, no. 5, p. 897–902, table, 1966.

Natural chalcopyrite was dissolved by NaCl solution at the warmer end of a reaction vessel and synthetic chalcopyrite was precipitated at the cooler end at temperatures of 400°–500°C. No transfer occurred with pure water.—W.S.W.

7185 **Bartholomé, Paul.** Corroded quartz grains in sedimentary ores of iron and manganese: Econ. Geology, v. 61, no. 5, p. 886–896, 1966.

Corroded quartz grains present in sedimentary ores of iron and manganese are evidence of high pH. Other things being equal, "the activity of iron [and manganese] necessary to cause precipitation is lower if precipitation occurs at a higher pH." Under conditions of high pH, it is possible that deposition of iron and/or manganese may have occurred from waters only ten times richer in these constituents than average near-surface seawater.—W.S.W.

6798 **Bartlett, G. A.** Foraminifera distribution in Tracadie Bay, Prince Edward Island: Canada Geol. Survey Paper 66-20, 54 p., illus., tables, 1966.

Tracadie Bay, characterized by a lagoonal environment, is shallow and within the brackish water regime, its free circulation with the Gulf of St. Lawrence restricted by a baymouth bar. Sediments derived from the bar and surrounding coastal areas are filling the bay. Organic carbon and calcium carbonate content are highest in the finer sediments. Recent foraminiferal fauna, smaller in population than more open bays, but comparable to inner lagoon assemblages of southern latitudes, comprises over 50 percent calcareous hyaline tests at most stations. The distribution of seven species are distinctive to this bay; *Ammonia beccarii*, absent along Atlantic coastal areas north of Cape Cod, may be a local relict in this bay.—G.D.C.

7183 **Barton, Paul B., Jr.; Toulmin, Priestley, 3d.** Phase relations involving sphalerite in the Fe-Zn-S system: Econ. Geology, v. 61, no. 5, p. 815–849, illus., tables, 1966.

The system Fe-Zn-S was studied from 850°C (appearance of sphalerite-wurtzite polytypes) to 580°C (where reaction rates become very slow), with control of sulfur fugacity. Results show that temperatures estimated from the "sphalerite geothermometer," which was based on techniques in which sulfur fugacity was not controlled, may be in serious error. Where sulfur fugacity is buffered by pyrrhotite-pyrite, Fe-content of sphalerite changes from 13 mole percent at 742°C to 19 mole percent at 580°, but compositions cannot be extrapolated to lower temperatures. Other sulfide assemblages that define sulfur fugacity at various temperatures form a potential basis for quantitative geothermometry using Fe-content of sphalerite.—W.S.W.

Bassett, A. M. *See* Dibblee, T. W., Jr. 6701

Bastron, Harry. *See* Lee, Donald E. 7120

6803 **Bateman, Andrew F., Jr.** Montana's coal resources, *in* Montana Coal Resources Symposium, 1st, 1964, Proc.: Montana Bur. Mines and Geology Spec. Pub. 36, p. 6–11, illus., 1966.

Coal-bearing rocks underlie about 35 percent of Montana's total area. Coal in the ground is estimated at 222,047 million tons, of which 2,363 million tons are bituminous, 132,151 million subbituminous, and 87,533 million lignite. Short descriptions of five widespread coal-bearing formations of Jurassic to Eocene age are given, and the fields are discussed by areas. A map shows the distribution of coal in the State, and of the areas discussed.—E.S.L.

7169 **Beall, John V.** Coeur d'Alene profile, 1966: Mining Eng., v. 18, no. 7, p. 163–178, illus., tables, 1966.

A brief review of the history, geology, and exploration of this silver-lead-zinc district is followed by a more detailed description of mining and concentration methods,

and production statistics of nine mines operated by five companies in the area.—C.B.D.

Beatty, L. B. *See* Gulbrandsen, R. A. 7035

6805 **Beckman, W. A., Jr.; Sloss, L. L.** Possible pre-Springeran unconformity in southern Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1342–1364, illus., 1966.

The complex relations of the Goddard Formation with older rocks in the Madill–Aylesworth area of Marshall and Bryan Counties, Okla., is atributed to an unconformity as well as previously postulated faulting. The Goddard is believed to have been deposited over the Caney shale and older rocks which had been truncated by erosion of a Late Mississippian anticline. This local uplift and erosion may have been coincident with similar events in the Ouachita province and is correlated with the widespread Late Mississippian to Early Pennsylvanian unconformity (the lacuna between the Kaskaskia and Absaroka sequences).—E.K.M.

Behre, Charles H., Jr. *See* Rouse, John T. 6784

7009 **Bender, Margaret M.; Bryson, Reid A.; Baerreis, David A.** University of Wisconsin radiocarbon dates II: Radiocarbon, v. 8, p. 522–533, 1966.

Radiocarbon dates obtained since November 1964 are summarized on archeologic samples from Iowa, Missouri, Wisconsin, Texas, and Oklahoma; and on geologic samples from Northwest Territories, Manitoba, and Colorado.—M.C.M.

7098 **Benedict, James B.** Radiocarbon dates from a stone-banked terrace in the Colorado Rocky Mountains, U.S.A.: Geog. Annaler, v. 48A, no. 1, p. 24–31, illus., table, 1966.

Niwot Ridge, west of Boulder, Colo., has near its center a group of stone-banked terraces on a snow-accumulation slope. Inactive sorted polygons at the crest grade downslope into extensive talus below the edge of which the stone-banks occupy the steepest portion of the slope. Their steep and rocky fronts have overridden turf-banked terraces. Beneath the stones is a layer of platy loam, and below that the original A–C soil profile. Radiocarbon dates on the entire thickness of the A horizon suggest that the terrace originated 3,000 to 2,500 yr ago, during waning of the Temple Lake glacial epoch. Two periods of rapid downslope movement occurred, each reflecting saturated but snow-free soil at the beginning of a freeze-up, or at the end of a glacial maximum as terraces emerged from snowbanks. No velocity increase during the more recent Gannett Peak time is indicated.—G.D.C.

6717 **Bennett, Richmond.** Carbon-14 dating of ground water in an arid basin, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 590–596, illus. [1966?].

Rocks forming the mountains bordering the Tucson Basin in the Sonoran Desert of Arizona, are described. The basin is filled with Tertiary and Quaternary alluvium, and the main source of ground-water recharge is seepage from streams. The techniques for sampling and analyzing water from wells is given. The analyses show a progressively greater C-14 age as the center of the basin is approached from a recharge area, and bring out the influence of pumping centers. This method will give the first data from which ground-water velocities and relative recharge can be determined.—E.S.L.

6962 **Benson, M. A.; Thomas, D. M.** A definition of dominant discharge: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 2, p. 76–80, illus., table, 1966.

The concept of dominant (stream) discharge in geomorphology has not been firmly defined. By defining it, on rational grounds, as that discharge at which, over a long period of time, most sediment has been transported, a definite value can be computed for a stream for which there are available duration-curve values of daily discharge and a sediment-rating curve. This has been done for 5 eastern and 4

western rivers. The dominant discharge, when expressed in terms of percentage duration, is remarkably consistent, and is found to be a lower discharge than has generally been considered dominant.—Authors' abstract

6864 **Berg, Eduard.** Triggering of the Alaskan earthquake of March 28, 1964, and major aftershocks by low ocean tide loads: Nature, v. 210, no. 5039, p. 893–896, illus., table, 1966.

It is calculated that during a half-tide cycle, pressure varies by about 0.3 kg per cm^2 on the ocean floor of the shelf area of Alaska; this pressure variation could have triggered the main earthquake of March 1964 and the subsequent aftershocks (excluding the first 24 hours) of $M \geq 5.5$. A "creep" fracture is assumed to be involved. Crustal unloading might initiate fracture when the pressure variation is one percent or less of total fracture stress, and failure occurs much more rapidly if a small cyclic variation is superposed on a continuous one; an upper limit of about 30 kg per cm^2 (diminishing with increasing depth) is calculated for the failure stresses encountered.—D.B.V.

Berg, Joseph W., Jr. *See* Trembly, Lynn D. 7096

6789 **Berg, Robert E.; Romberg, Frederick E.** Gravity profile across the Wind River Mountains, Wyoming: Geol. Soc. America Bull., v. 77, no. 6, p. 647–655, illus., 1966.

Analysis of the gravity profile, which has a relief of 100 mgal, confirms that the southwest flank of the mountains is underlain by a major low-angle thrust fault. The interpreted amplitude of the fault and calculated thickness of the thrust wedge of higher density Precambrian crystalline rocks depend on the density contrast used.—A.G.

7041 **Berger, Jon; Cok, A. E.; Blanchard, J. E.; Keen, M. J.** Morphological and geophysical studies on the eastern seaboard of Canada—The Nova Scotian Shelf, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 102–113, illus., 1966.

This shelf, a northern extension of the submerged Atlantic Coastal Plain, ends abruptly on the northeast at the Laurentian Trough, extends southeastward to 230 km offshore, and narrows southwestward to 100 km. Its relief is illustrated by five assumed stages of exposure as present sea level is reduced by 274 m. Carboniferous strata may outcrop on the edge of Laurentian Channel, continuing in moderate relief from Cape Breton Island. Southeast of Nova Scotia, Precambrian Meguma slates and quartzites give irregular topography for 20 km to an inferred fall line, there covered by flat-lying strata suggested as post-Jurassic and Tertiary. Random flat-top highs, explained as glacial moraine, lie within marginal banks deposited during presumed Cretaceous emergence. Seismic profiles southeast of Halifax indicate crustal thickness of 32.8 under Long Lake, and 35 km at Sable Island.—G.D.C.

6901 **Berger, Rainer; Ting, William S.; Libby, Willard F.** Coprolites in western caves, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 731–744, illus., tables [1966?].

A material, called Amberat, composed of packrat excrement on the way to becoming coprolite, has been found in caves in Montana, Utah, Nevada, California, and Arizona. Samples from Pintwater Cave, Nevada, yielded C-14 ages of 15,000 to 16,000 years. Pollen analysis showed the material to be very rich in pollen, with a predominance from Chenopodiaceae and Compositae. The overall appearance of the flora does not suggest any severe change in climate since about the time the Amberat formed. The very arid environment may have caused the packrats to leave.—E.S.L.

6942 **Berger, Rainer; Libby, W. F.** UCLA radiocarbon dates V: Radiocarbon, v. 8, p. 467–497, illus., 1966.

Radiocarbon measurements carried out during 1965 are reported on archeologic-historic samples from California, Nevada, Mexico, Peru, Brazil, Philippines, Spain,

England, Egypt, and Africa. Geophysical, geological–climatological and biological measurements are given for: C–14 in atmospheric carbon dioxide (California), bomb C–14 in foodstuffs (California, Australia, Colombia), bomb C–14 in human tissues (widespread localities), bomb C–14 in plants (Colorado), oceanic measurements (California, Mexico), vegetation and climate (California, Texas, Nevada), and geological processes (California, Israel).—M.C.M.

6863 **Berger, W. H.** Distinguishing juvenile Foraminifera in plankton samples by using biological dyes: Jour. Paleontology, v. 40, no. 4, p. 975–976, 1966.

Methyline blue tends to stain specimens of Foraminifera if applied in a dilute water solution to a wet sample. Both adult and juvenile specimens of each of a number of planktonic foraminiferal species tested tend to stain the same hue, thus facilitating the assignment of often hard to identify juvenile specimens to the correct species.—J.F.M.

6824 **Bergquist, Harlan R.** Micropaleontology of the Mesozoic rocks of northern Alaska: U.S. Geol. Survey Prof. Paper 302–D, p. 93–227, illus., tables, 1966.

More than 15,000 samples of Paleozoic to Pleistocene rocks were studied as part of the U.S. Navy's petroleum exploration in northern Alaska—more than 11,000, mainly Cretaceous, from 81 core tests and test holes. Each Cretaceous formation is discussed with its microfauna, mainly foraminifers and radiolarians; six microfaunal zones from Albian to Senonian are described: *Gaudryina tailleuri, Verneuilinoides borealis, Gaudryina irensis–Trochammina rutherfordi, Hedbergella loetterlei–Heterohelix globulosa, Pseudoclavulina hastata–Arenobulimina torula, Neobulimina canadensis*. Microfaunas from each test hole are described and listed on charts. Strata in Umiat field, Barrow–Simpson–Fish Creek and Topagoruk areas are correlated by faunal zones.—V.M.J.

7008 **Bermingham, Anne.** Victoria natural radiocarbon measurements I: Radiocarbon, v. 8, p. 507–521, 1966.

A selection of results of radiocarbon measurements made since September 1963 are listed for geologic samples from Australia, archeologic samples from Australia and India, and cross-check samples from Italy, Netherlands, Iraq, Wisconsin, and Denmark.—M.C.M.

6776 **Berry, William B. N.** Zones and zones—With exemplification from the Ordovician: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1487–1500, tables, 1966.

Recent literature reveals that the term "zone" includes a multitude of uses both descriptive and interpretive, and, despite the fact that the word "zone" may apply to different phenomena, no common understanding of its several possible meanings is apparent, although several were discussed by the American Commission on Stratigraphic Nomenclature and the International Subcommission on Stratigraphic Terminology. Attention here is focused on some long and widely used meanings of "zone" not discussed in reports of the above committees. Correlations of British and North American Early and Middle Ordovician graptolite zones are proposed and recommendation for study of wider latitude in use of term "zone" is made.—S.P.S.

6883 **Bianchi, W. C.; Haskell, E. E., Jr.** Air in the vadose zone as it affects water movements beneath a recharge basin: Water Resources Research, v. 2, no. 2, p. 315–322, illus., 1966.

The shape of the advancing wet front beneath an experimental recharge area can be attributed to the distribution of entrapped air above it. The apparent rise of the water table prior to the arrival of the wet front results from a localized response of observation wells to pressures associated with air movements between the water table and wet front. The curvature of the wet front and the premature response of the observation wells make it difficult to determine, from observation well hydrographs, the initial position of the 'static' water table and the time that recharge commences.—Authors' abstract

6835 **Birch, Francis.** Earth heat flow measurements in the last decade, *in* Advances in Earth science—Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 403–430, illus., 1966.

In the determination of heat flow, nine tenths of the more than 1,000 values observed since 1954 were made through the sea floor. Remarkably close oceanic and continental values have revolutionized conceptions of radioactivity distribution and of thermal regime, and reversed direction of mantle convection currents, requiring variety in their sizes and shapes. In deep continental work uncertainties of lateral disturbances may be reduced if bore holes are close enough to permit construction of isothermal surfaces. Sea-floor muds, and seaborne mobility, make rapid accumulation of data possible; but locally disturbing conditions are obscured by sea water, and configuration of underlying hard rocks is usually not known. A group of ten closely spaced oceanic determinations is roughly equivalent to a 1,000-ft continental hole; the standard of error is about three times greater.—G.D.C.

6893 **Bird, James M.** Well log applications and interpretation in a brine field, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 57–69, illus., 1966.

Data gathering services in the wire-line industry as applied to experience in the salt mining field are discussed. In the information evaluation group, the Gamma Ray–Neutron Stack is most useful for taking measurements in open or cased, empty or fluid-filled holes. A Guard tool, a focused current device, is excellent for thin bed definition, such as in a very low resistivity brine-filled hole. The Formation Density tool utilizes a gamma-ray source and gamma-ray detector, shielded from each other; a double elbow allows the lower part to remain in contact with the wall in holes up to 10 inches diameter, and in washout zones more than three feet thick. There is room for improvement in tool design and logging techniques, but electrical tools developed for the oil and gas industry can be useful in brine wells.—G.D.C.

6812 **Birot, P.** Observations sur le relief de deux petits batholites de granodiorite à Porto Rico et à la Jamaïque: Koninkl. Nederlandsch Aardrijksk. Genoot. Tijdschr., ser. 2, v. 83, no. 3, p. 220–226, illus., 1966.

The granodiorite batholiths at Utuado, Puerto Rico, and Above Rocks, Jamaica, have eroded more rapidly than both the Cretaceous rocks intruding them and the Eocene limestones surrounding them. This must be due in part to the relative permeability of the rocks. Soil profiles and argillization are less advanced than on other crystalline basement rocks in tropical areas, partly because of the rapid rate of uplift, some of it Quaternary. Also the silica content of Antillean waters is higher than that in the older crystallines.—E.S.L.

Blake, W., Jr. *See* Dyck, W. 6947

Blanchard, J. E. *See* Berger, Jon. 7041

6708 **Blank, H. Richard, Jr.** U.S.-Japan caldera conference: Am. Geophys. Union Trans., v. 47, no. 2, p. 379–381, 1966.

A joint U.S.-Japanese caldera conference was held in Washington, D.C., on September 21–24, 1965, in conjunction with a project for a cooperative program of combined aeromagnetic and gravity investigations of Japanese calderas. The conference was preceded by a five-day field trip to calderas and ash-flows in the western United States. Papers given at the conference dealt with several Japanese calderas and calderas in Hawaii, the Aleutian Islands, and the United States. D.B.V.

7115 **Blank, H. Richard, Jr.** General features of the Bouguer gravity field in southwestern Oregon, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C113–C119, illus., 1966.

A contoured Bouguer anomaly map of a region 75 miles wide and 130 miles long shows an average west-to-east negative gradient that corresponds qualitatively to an inland thickening of the continental crust. Gravity highs in the Coast Range may reflect ultramafic bodies at depth as well as near-surface accumulations of lower Eocene basalt. Anomalous northeast trends in the Cascade Range are attributed to a concealed extension of the Klamath Mountains upwarp. A negative anomaly not exceeding 10 mgals is associated with the Crater Lake caldera, and a negative anomaly of 20 to 30 mgals coincides with the northern end of the Klamath graben.—Author's abstract

7188 **Bloom, Harold.** Geochemical exploration in 1965 *in* The search for ore: Mining Eng., v. 18, no. 2, p. 75–77, illus., 1966.

Geochemical prospecting continues to be widely used in the eastern and western coastal areas of northern United States and Canada, Ireland, Africa, Australia and some islands of the South Pacific. New sensitive gold, silver, and mercury tests have been used to investigate relationship of these metals to ore deposits. A long term exploration program will appraise the mineral potential of the primitive and wilderness areas of the United States by using a new truck mounted camper as a field laboratory. The atomic absorption spectrophotometer and remote sensing instruments are the newest exploration tools.—C.B.D.

Bloss, F. Donald. *See* Fang, J. H. 6891

7004 **Bloss, F. Donald.** Suggested terminology for interstratified clay minerals: Am. Mineralogist, v. 51, nos. 5–6, p. 855–857, 1966.

Hyphenated numbers are used to designate regularly alternated interstratifications; 2-2 mica-montmorillonite has two mica layers followed by two montmorillonite layers. Random intergrowths are indicated by percentages of each component, as 30-70 mica-montmorillonite. The terms 1:1 and 2:1 are retained to designate kaolin-type or mica-type layers.—M.L.L.

6958 **Bloxam, T. W.** Jadeite-rocks and blue schists in California: Geol. Soc. America Bull., v. 77, no. 7, p. 781–786, illus., table, 1966.

Because of inappropriate bulk composition graywackes seldom develop into blue schists, and most blue schists appear to have developed from mafic igneous rocks and retrograde eclogites. Metasomatic formation of blue schists from graywackes around some mafic igneous rock bodies is believed to be due to chemical changes that preceded metamorphism.—J.J.H.

Boardman, C. *See* Rawson, D. 6724

6690 **Bodine, Marc W., Jr.; Goddard, John G.** Dry synthesis of K(Cl, Br) solid solutions—A laboratory project in crystal chemistry for introductory mineralogy: Jour. Geol. Education, v. 14, no. 1, p. 15–16, 1966.

In the laboratory experiments described by Roberson and Durisek (ibid., p. 12) the data when plotted against composition of the solutions show a definite non-linear relationship, and some scattering as a function of the extent of precipitation. With prolonged precipitation, changes in the Cl-Br ratio of both brine and crystals are well known effects. The feasibility of synthesizing the mixed crystals using only the components of the system in a dry environment was investigated, with essentially linear results and little or no scattering of data. The experiments are not time consuming and involve a minimum of expense and supervision, and the reaction products are well homogenized single phases whose properites illustrates the properties of a solid solution system.—G.D.C.

Boegly, W. J., Jr. *See* Empson, F. M. 6696

Boelrijk, N. A. I. M. *See* Priem, H. N. A. 7204

6808 **Boggs, Sam, Jr.** Petrology of Minturn Formation, east-central Eagle County, Colorado: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1399–1422, illus., table, 1966.

The Minturn Formation of central Colorado accumulated from early Des Moines time through Middle and Late(?) Pennsylvanian. The formation was deposited in a narrow trough adjacent to the mobile, ancestral Front Range uplift. The stratigraphic sequence consists of detrital sediments with interbedded carbonate and evaporite beds.—A.E.R.

7131 **Bohn, Ernst; Stöber, Werner.** Coesit und stischowit als isolierte naturliche Mineralien [with English summ.]: Neues Jahrb. Mineralogie Monatsh. 1966, no. 3, p. 89–96, illus., table, 1966.

A procedure is described by means of which coesite and stishovite have been isolated from the Coconino Sandstone at Meteor Crater, Arizona, yielding 2.5 and 0.08 percent, respectively. The particle size distribution of the mineral powders obtained was determined, and the solubility in HF and in water was checked. Coesite is much less soluble in HF than quartz, and stishovite not at all; however, in pure water stishovite is more soluble than coesite or quartz.—D.B.V.

7027 **Bold, W. A. van den.** Ostracoda from the Antigua Formation (Oligocene, Lesser Antilles): Jour. Paleontology, v. 40, no. 5, p. 1233–1236, illus., tables, 1966.

Twenty species of ostracodes are listed and the ranges of Ostracoda, planktonic Foraminifera, and larger Foraminifera in the Antigua Formation and in Puerto Rico and Trinidad are illustrated. The Antigua Formation is considered to contain most of the *Globigerina ampliapertura* and all of the *Globorotalia opima opima* biozones. The Oligocene–Miocene boundary is placed at the top of the *Globigerina ciperoensis ciperoensis* biozone. Correlations of formations in Trinidad, Antigua, and Puerto Rico with biozones and with time-stratigraphic units are illustrated.—J.F.M.

Bolter, Ernst. *See* Turekian, Karl K. 6978

Bolter, Ernst. *See* Turekian, Karl K. 7021

6886 **Boltovshoy, Esteban.** Methods for sorting of Foraminifera from plankton samples: Jour. Paleontology, v. 40, no. 5, p. 1244–1246, table, 1966.

The main methods for the removal of planktonic Foraminifera from plankton samples are described and compared. A new method in which a portion of the sample is dried on filter paper, disentangled from algae etc. by gentle agitation, and then picked while dry is described and compared to the other methods.—J.F.M.

Bond, Ernest W. *See* Botz, Maxwell K. 6672

6895 **Borden, Charles E.** Radiocarbon and geological dating of the Lower Fraser Canyon archaeological sequence, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 165–178, illus. [1966?].

Nine millennia are dated by C-14 in two sites in the Lower Fraser Canyon, and one on river terraces of the river near Yale, British Columbia. Stratigraphy of the sediments at the gorge sites is given, with the archeological zones. The three terraces at the South Yale site are described, along with the crude stone tools. Around 11000 B.C. the area was occupied by an inlet of the Strait of Georgia, and the valley was filled with up to 350 feet of deltaic deposits. The upper terrace was cut and much of the surface of the 250 ft terrace exposed periodically in the late Everson Interstade between 10500 to 9000 B.C. Then the river was ponded and the sites inundated as a result of the Sumas ice dam. From before 7000 to 6000 B.C., the 200 ft terrace was cut. The cobble tools recovered from the South Yale site contrast with the sophisticated tools of the same age at the Milliken site upstream.—E.S.L.

6833 **Bostock, H. S.** Notes on glaciation in central Yukon Territory: Canada Geol. Survey Paper 65-36, 18 p., illus., geol. map, 1966.

Two clearly defined series of glacial limit features, readily correlated and traced from place to place, are inferred to mark the limits of the last glacial advance in central Yukon. These are the McConnell Moraine and an earlier advance, the Reid Moraine. In addition, older glacial drift, till, erratics and modified land forms have been found beyond the clearly marked limits, and perhaps record two earlier glaciations. These earlier features are referred to as the Klaza Drift (the younger) and the Nansen Drift (the older).—Author's abstract

7036 **Bottinga, Y.; Kudo, A.; Weill, D.** Some observations on oscillatory zoning and crystallization of magmatic plagioclase: Am. Mineralogist, v. 51, nos. 5-6, p. 792-806, illus., table, 1966.

Measurements of concentration gradients in the boundary layers adjacent to plagioclase-volcanic glass interfaces indicate that plagioclase crystallization rate is diffusion controlled during certain stages of growth. A modified version of the theory of Harloff (1927) is offered as the most likely explanation of oscillatory zoning in plagioclase. Clouded plagioclase may result from the co-precipitation of plagioclase and iron and magnesium rich phases due to a build up of iron and magnesium in the boundary layer during plagioclase growth. The petrologic significance of plagioclase-magmatic liquid equilibrium pairs is considered.—Authors' abstract

6672 **Botz, Maxwell K.; Bond, Ernest W.** Index map and bibliography of ground-water studies in Montana: Montana Bur. Mines and Geology Spec. Pub. 37, scale about 1 in. to 19 mi., 1966.

6853 **Bowser, C. J.; Dickson, F. W.** Chemical zonation of the borates of Kramer, California, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 122-132, illus., 1966.

In the lake beds at Kramer, a central borax body, surrounded above and laterally by beds containing ulexite and colemanite and below by beds containing only ulexite, may reflect an earlier zonation that developed during or shortly after deposition of the Kramer lake beds. The ulexite shows textures identical to nodular ulexite of several localities where it has formed by replacement of muds of modern playas; the borax at Kramer was deposited on lake muds in response to evaporation of saturated $Na_2B_4O_7$ brines. Textural and structural data, together with the spatial distribution of the borates in the lake beds, suggest that subsurface reaction of calcium-bearing ground water with the borax ore body, or with sodium borate-rich brines trapped in the lake muds, produced the less soluble nodular ulexite and colemanite. A less probable mechanism involves cation exchange of brines and clays.—G.D.C.

Boyd, F. R. *See* Davis, B. T. C. 6900

6679 **Bradley, W. H.** Paleolimnology of the trona beds in the Green River Formation of Wyoming, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 160-164, illus., 1966.

More than a score of trona, or trona and halite, beds have been found in the Wilkins Peak Member of the Green River Formation; their areal extent is much smaller than that of the Wilkins Peak lake beds. Mineral and organic constituents of the trona beds indicate their deposition at the bottom of a shallow lake that alternated between strong brine concentration and low salinity. Inferred shoals partially isolated an area of Eocene Gosiute Lake in the central and south-central Green River Basin, so that this small area received less inflow from streams than did the rest of the lake. At low stages, it became an evaporating sump into which saline water flowed from the other two parts of the lake, concentrating the brine in the southern Green River Basin.—G.D.C.

Bradshaw, R. L. *See* Empson, F. M. 6696

6838 **Branson, Carl C.** Fresh-water ostracode genus *Theriosynoecum*: Oklahoma Geology Notes, v. 26, no. 4, p. 87–96, illus., 1966.

Taxonomy of the Jurassic–Early Cretaceous genus *Theriosynoecum* Branson, 1936, is reviewed; the original description (*Morrisonia* Branson, 1935) has been emended by others and is here further emended. Family and subfamily assignments are tabulated. Description of the type species, *T. wyomingense* (Branson, 1935), from a fresh-water lentil in Upper Jurassic Morrison Formation, Johnson County, Wyo., is emended, with orientation corrected and dimorphism recognized. Synonymies are given for 20 additional species described in the genus by others, or transferred from *Bisulcocypris Metacypris, Gomphocythere*, and other genera. These assignments are regarded as too inclusive; four groups of species are suggested.—V.M.J.

6841 **Branson, Carl C.** *Conocardium* in the Bromide Formation (Ordovician) of Oklahoma: Oklahoma Geology Notes, v. 26, no. 3, p. 78–79, illus., 1966.

A minute specimen of the pelecypod *Conocardium*, unnamed species, is described and figured from the Pooleville Member of the Bromide Formation at Rock Crossing, Carter County, Okla. The genus comprises about 160 named species ranging from Chazyan (Ordovician) to Guadalupean (Permian). Eight named Ordovician species, five from eastern and central North America (none from Oklahoma), are listed with horizon and locality, but no comparisons are made.—V.M.J.

6932 **Branson, Carl C.** *Reticulariina* in Oklahoma: Oklahoma Geology Notes, v. 26, no. 4, p. 115–116, illus., 1966.

A dorsal valve of the spiriferoid brachiopod *Reticulariina*, from the Fayetteville Shale (Mississippian, Chester Series) near Vinita, Craig County, Okla., differs markedly from *R. spinosa* (type species) in shape of the fold and number of lateral plications; a new species is indicated but is not named here from the single valve. By coincidence, a single ventral valve of *Punctispirifer transversus*, similar in size and general appearance, was found in the same lot. *Reticulariina* is confined to Mississippian rocks of the U.S.; *R. spinosa* is widespread in Chesterian rocks of the U.S. Relationships and ranges of other species of the genus, and species of *Spiriferina and Punctispirifer* are discussed.—V.M.J.

6935 **Branson, Carl C.** New genus of spiriferid brachiopod from Oklahoma and Texas: Oklahoma Geology Notes, v. 26, no. 3, p. 74–78, illus., 1966.

Eridmatus texanus (Meek, 1871), new combination, is redescribed and specimens from the Pennsylvanian of Okfuskee, Seminole, and Pontotoc Counties, east-central Okla., are figured. The species was described originally as *Spirifer (Trigonotreta?) texanus* from lower Cisco, probably Graham Formation, Young County, Tex., and as *Neospirifer texanus* by Dunbar and Condra (1932) from Nowata County, Okla. In Oklahoma it ranges from late Desmoinesian (Lenapah) to middle Missourian (Nelly Bly); in central Texas, where it is reported also from Brown, Jck, and Palo Pinto Counties, it ranges from early Missourian (Graford) to early Virgilian (Graham).—V.M.J.

Brent, Millard D. *See* Lokke, Donald H. 6912

6796 **Briggs, John C.** Oceanic islands, endemism, and marine paleotemperatures: Systematic Zoology, v. 15, no. 2, p. 153–163, illus., 1966.

Available data on the marine shore faunas of the old (apparently Pliocene or earlier) and well isolated oceanic islands reveal a very interesting pattern of endemism, low in the north and middle Atlantic, markedly greater in the south Atlantic and Pacific, and exceedingly high in the sub-Antarctic waters. It is suggested that this pattern may be correlated with the extent of the drop in sea surface temperature during Pleistocene glaciations. Contrary to most of the literature on the subject, it seems that the effect of the ice ages on ocean temperature may have been quite different in various parts of the world. The islands that demonstrate the least amount of endemism were probably exposed to the greatest decline in surface temperature.—*from* Author's abstract

Broan, R. J. E. *See* Johnston, G. H. 7048

Brock, M. R. *See* Heyl, A. V. 7121

Broecker, W. S. *See* Thurber, David L. 6909

Brown, C. Ervin. *See* Thayer, T. P. 7110

7182 **Brown, Jerry; Sellmann, Paul V.** Radiocarbon dating of coastal peat, Barrow, Alaska: Science, v. 153, no. 3733, p. 299–300, illus., 1966.

A buried, frozen section of peat from sea level yielded radiocarbon dates between 700 and 2,600 B.C.; it suggests burial by a transgressing sea.—Authors' abstract

6797 **Brummer, J. J.** Northwest quarter of Holland township, Gaspé–North county [also French edition]: Quebec Dept. Nat. Resources Geol. Rept. 125, 95 p., illus., tables, geol. map, 1966.

This map-area on the Gaspé Peninsula covers part of the central synclinorium of Devonian strata intruded by dikes and sills of quartz-feldspar porphyry and by diabase dikes. Western areas have been altered by high-temperature metamorphism and bleaching, related to a granite cupola of the McGerrigle batholith. Two types of economic copper deposits with traces of tungsten and molybdenum are found in these altered areas: bedded replacement in calcareous siltstones and limestone, and mineralization along closely spaced joints. Sedimentary formations and igneous rocks, structural relations, metamorphism, and mineral deposits are described. Typical examples of pyrometasomatic deposits are in the Aiguille Mountains area. At Copper Mountain hydrothermal veins followed pyrometasomatic replacement. Traces of lead and zinc are found along faults in the periphery of the altered zones.—G.D.C.

Brune, James N. *See* Oliver, Jack. 6955

7006 **Brydon, J. E.; Kodama, H.** The nature of aluminum hydroxide-montmorillonite complexes: Am. Mineralogist, v. 51, nos. 5–6, p. 875–889, illus., tables, 1966.

Aluminum hydroxide-Wyoming bentonite complexes were compared with dioctahedral chlorite and with various synthetic pure aluminum hydroxides by X-ray diffraction, DTA, TGA and IR absorption. Aluminum hydroxide enters entirely into the interlayer of montmorillonite, and assumes a gibbsite-like monolayer structure in amounts up to 8 me Al/gm clay. Beyond this amount, but below the amount required for a perfect gibbsite layer, some hydroxide is present external to the montmorillonite interlayer. On heating, there was an interaction of the interlayer hydroxide with the montmorillonite so that montmorillonite hydroxyl was liberated at below the characteristic temperature.—*from* Authors' abstract

Bryson, Reid A. *See* Bender, Margaret M. 7009

6810 **Bukhari, S. A.; Lennox, D. H.** A generalized method of numerical resistivity analysis: Geophysics, v. 31, no. 3, p. 625–626, 1966.

Attention is drawn to Research Council of Alberta Bulletin 19, by Bukhari and Lennox (1966), which reports on continuing work on resistivity analysis. In that work, two more operators are computed, corresponding to specified subsurface geometries and sequences of electrode positions, and a table is presented of geometric coefficients for certain selected subsurface blocks and dipole-dipole electrode configurations from which the coefficients for many more blocks can be derived. With this table, operators can be computed for a great variety of subsurface block arrays, facilitating the selection of arrays useful for many diverse geological situations.—D.B.V.

7032 **Burns, R. G.; Fuerstenau, D. W.** Electron probe determination of interelement relationships in manganese nodules: Am. Mineralogist, v. 51, nos. 5–6, p. 895–902, illus., 1966.

This paper describes methods by which element correlations may be determined with the electron-probe, and summarizes the results obtained by electron-beam scanning and specimen traversing.—E.H.R.

7152 **Butler, C. P.** The meteorites of California: California Div. Mines and Geology Mineral Inf. Service, v. 19, no. 7, p. 103–106, illus., table, 1966.

From 1869 to 1965, a total of 1,494 kg of meteoric iron and 89 of stony meteorites has been picked up in California, representing 19 finds, which are tabulated in chronological order. On the average, one meteorite should fall somewhere in California every two years. The question is raised as to why only seven have been discovered. No statewide program for their recovery has been attempted, although such programs have been very successful in other states. The importance of seeing that any discoveries are turned over to a museum for safekeeping is emphasized by examples of lost California meteorites.—E.S.L.

7064 **Bycroft, G. N.** Surface displacements due to an underground explosion: Seismol. Soc. America Bull., v. 56, no. 4, p. 877–888, illus., 1966.

A simple solution to the problem of surface displacements on an elastic half-space caused by an underground explosion is presented. The analysis is based on deriving the transient case for a point source from the steady state point source and then proceeding to the case of a finite spherical cavity by means of a retarded potential. Theoretical values of maximum displacement compare favorably with measured values from the underground test shot Rainier, a nuclear explosion of Operation Plumbob.—Author's abstract

7150 **Byers, F. M., Jr.; Rogers, C. L.; Carr, W. J.; Luft, S. J.** Geologic map of the Buckboard Mesa quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-552, scale 1:24,000, sections, 1966.

7123 **Cahen, L.** Memorial to Arthur Holmes (1890–1965): Geol. Soc. America Bull., v. 77, no. 7, p. P127–P135, portrait, 1966.

California Div. Mines and Geology. *See* U.S. Geological Survey. 6670

7014 **Callow, W. J.; Baker, M. J.; Hassall, Geraldine I.** National Physical Laboratory radiocarbon measurements IV: Radiocarbon, v. 8, p. 340–347, 1966.

Radiocarbon measurements made since NPL III (1965) and complete to end of November 1965 are given for archeologic and geologic samples from England, Scotland, Wales, Quebec, and Egypt.—M.C.M.

6913 **Calvert, S. E.** Accumulation of diatomaceous silica in the sediments of the Gulf of California: Geol. Soc. America Bull., v.77, no. 6, p. 569–596, illus., tables, 1966.

Diatoms are the chief source of opal in the sediments of the Gulf; radiolarians constitute less than 10 percent by weight, and sponge spicules are insignificant. Sediments that contain more than 10 percent opal by weight are restricted to the central part of the Gulf but may exceed 50 percent of the Guaymas Basin. Biogenous silica accumulates at a rate of approximately 10^{13} g per year in the central Gulf and terrestrial sources supply about 10^{11} g per year; Pacific Ocean waters contribute about 10^{14} g per year. Sufficient silica is available in areas of upwelling to account for the rich diatomaceous sediments in the basins without recourse to volcanic sources.—J.G.V.

7042 **Cameron, H. L.** The Cabot fault zone, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 129–140, illus., 1966.

The segments of Cabot fault appear to form parallel faults of high-angle thrust and small horizontal movement. The original fracture, Devonian(?) or older, is parallel to general trends of the Appalachian geosyncline, and its movements and those between the fault blocks resulted in basin-range topography and local basins for Carboniferous deposition. Only the Chedabucto offset resembles a transcurrent

fault, similar to the newly postulated Kelvin fault. Indirect evidence suggests right-hand movement of less than 2 mi. Direct evidence suggests the high-angle thrusts were caused by compression, believed to have been part of geosynclinal collapse. A re-examination of Great Glen fault for high-angle thrust relations is suggested; its resemblance to Cabot faults, suggested by Wilson (1962), is not very striking.—G.D.C.

6731 **Campbell, John M.** Radiocarbon dating and far northern archeology, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 179-186 [1966?].

Those characteristics of the far north which affect the validity of radiocarbon dating of archeological remains are considered. Two major variables in favor of the collector of C-14 dates are permafrost and the extremely slow dessication and decay of organic materials. Characteristics which may adversely affect dating are divided into chemical or related variables, and mechanical variables. It is concluded that there are few if any chemical factors unique to the north which cause dates from those regions to be suspect. Three major mechanical conditions which seem to have caused the most difficulty are solifluction, intense differential freezing and thawing over permafrost, and near-surface permafrost or large gravel.—E.S.L.

7099 **Campbell, R. H.; Yerkes, R. F.; Wentworth, C. M.** Detachment faults in the central Santa Monica Mountains, California, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C1-C11, illus., 1966.

The central Santa Monica Mountains are made up of sedimentary and volcanic rocks of Late Cretaceous through middle Miocene age that are probably underlain at depth by older metasedimentary and igneous rocks of the sort exposed in the core of the Eastern Santa Monica Mountains. Structurally, these strata form an autochthon(?) and three detachment thrust sheets that were emplaced during latest middle Miocene time, apparently from a source to the north. The thrust sheets are superimposed upon one another in a stratiform sequence which, in turn, has been folded and faulted, and dilated by igneous intrusion. On the south, these rocks and structures are truncated by the Malibu Coast fault, which trends east-west along the southern flank of the range.—Authors' abstract

6596 **Canada Geological Survey.** Aeromagnetic map, Larrys River, Guysborough county, Nova Scotia (2d edition): Canada Geol. Survey Geophysics Paper 231, scale 1:63,360, revised 1966; originally published 1955.

6597 **Canada Geological Survey.** Aeromagnetic map, Framboise, Cape Breton and Richmond counties, Nova Scotia (2d edition): Canada Geol. Survey Geophysics Paper 233, scale 1:63,360, revised 1966; originally published 1955.

6598 **Canada Geological Survey.** Aeromagnetic map, Country Harbour, Guysborough County, Nova Scotia (2d edition): Canada Geol. Survey Geophysics Paper 242, scale 1:63,360, revised 1966; originally published 1955.

6599 **Canada Geological Survey.** Aeromagnetic map, Frenchman Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3366, scale 1:63,360, 1966.

6600 **Canada Geological Survey.** Aeromagnetic map, Tadru Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3367, scale 1:63,360, 1966.

6601 **Canada Geological Survey.** Aeromagnetic map, Mica Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3368, scale 1:63,360, 1966.

6602 **Canada Geological Survey.** Aeromagnetic map, Little Kalzas Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3369, scale 1:63,360, 1966.

6603 **Canada Geological Survey.** Aeromagnetic map, Little Salmon River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3382, scale 1:63,360, 1966.

6604 **Canada Geological Survey.** Aeromagnetic map, Afe Peak, Yukon Territory: Canada Geol. Survey Geophysics Paper 3383, scale 1:63,360, 1966.

6605 **Canada Geological Survey.** Aeromagnetic map, Ragged Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3384, scale 1:63,360, 1966.

6606 **Canada Geological Survey.** Aeromagnetic map, Safety Pin Bend, Yukon Territory: Canada Geol. Survey Geophysics Paper 3385, scale 1:63,360, 1966.

6607 **Canada Geological Survey.** Aeromagnetic map, Snowcap Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3389, scale 1:63,360, 1966.

6608 **Canada Geological Survey.** Aeromagnetic map, Drury Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3390, scale 1:63,360, 1966.

6609 **Canada Geological Survey.** Aeromagnetic map, Harvey Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3391, scale 1:63,360, 1966.

6610 **Canada Geological Survey.** Aeromagnetic map, Dromedary Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3392, scale 1:63,360, 1966.

6611 **Canada Geological Survey.** Aeromagnetic map, Truitt Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3396, scale 1:63,360, 1966.

6612 **Canada Geological Survey.** Aeromagnetic map, Truitt Peak, Yukon Territory: Canada Geol. Survey Geophysics Paper 3397, scale 1:63,360, 1966.

6613 **Canada Geological Survey.** Aeromagnetic map, Tay Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3398, scale 1:63,360, 1966.

6614 **Canada Geological Survey.** Aeromagnetic map, Earn Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3399, scale 1:63,360, 1966.

6615 **Canada Geological Survey.** Aeromagnetic map, Fidler Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3670, scale 1:63,360, 1966.

6616 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 F/7, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3671, scale 1:63,360, 1966.

6617 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 F/10, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3672, scale 1:63,360, 1966.

6618 **Canada Geological Survey.** Aeromagnetic map, Pullan Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3673, scale 1:63,360, 1966.

6619 **Canada Geological Survey.** Aeromagnetic map, Pierce Lake, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3674, scale 1:63,360, 1966.

6620 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 G/3, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3698, scale 1:63,360, 1966.

6621 **Canada Geological Survey.** Aeromagnetic map, Munekun Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3699, scale 1:63,360, 1966.

6622 **Canada Geological Survey.** Aeromagnetic map, Asipoquobah Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3700, scale 1:63,360, 1966.

6623 **Canada Geological Survey.** Aeromagnetic map, Knife Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3701, scale 1:63,360, 1966.

6624 **Canada Geological Survey.** Aeromagnetic map, Blackbear Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3702, scale 1:63,360, 1966.

6625 **Canada Geological Survey.** Aeromagnetic map, Swan Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3703, scale 1:63,360, 1966.

6626 **Canada Geological Survey.** Aeromagnetic map, Sherman River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3704, scale 1:63,360, 1966.

6627 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 J/14, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3705, scale 1:63,360, 1966.

6628 **Canada Geological Survey.** Aeromagnetic map, Pasquatchai River, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3706, scale 1:63,360, 1966.

6629 **Canada Geological Survey.** Aeromagnetic map, Kistigan Lake, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3676, scale 1:63,360, 1966.

6630 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 K/15, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3677, scale 1:63,360, 1966.

6631 **Canada Geological Survey.** Aeromagnetic map, Stull Lake, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3675, scale 1:63,360, 1966.

6632 **Canada Geological Survey.** Aeromagnetic map, Pechabau River, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3708, scale 1:63,360, 1966.

6633 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 O/6, Kenora and Winnipeg Mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3707, scale 1:63,360, 1966.

6634 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 O/14, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3709, scale 1:63,360, 1966.

6635 **Canada Geological Survey.** Aeromagnetic maps, Scotian Shelf—Sheets 10K(5, 10–15); 10L(2–16); 10M(1–16); 10N(3–6, 11–14); 11C(3–6, 11–14); 11D(1–4, 6–9); 11F(1,2,7,8): Canada Geol. Survey Geophysics Papers 4823–4884, scale 1:63,360, 1966.

6671 **Canada Geological Survey.** Geological Survey of Canada field parties, 1966 (total 102): Canada Geol. Survey Prelim. Ser. Map 1–1966, scale about 1 in. to 19 mi., 1966.

6676 **Canada Geological Survey.** Aeromagnetic map, Pork Peninsula, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3498, scale 1:63,360, 1966.

7216 **Caputo, Michele.** Review of formulas for the space normal gravity field of the Earth, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 121–126, table, 1966.

Attention is called to a given set of formulas for computation of the normal gravity field in space surrounding the Earth and to the adjustment of parameters, because the theory from which they are obtained is simple and because of the coordination that they achieve between gravimetric and geometric geodesy. Formulas developed in closed form by Pizzetti and Somigliana for the Earth's rotating gravity field recently extended to space surrounding the Earth are summarized, and equivalent formulas are given for the nonrotating gravity field of the Earth.—V.S.N.

7222 **Caputo, Michele.** Gravity surveys at sea by the Institute of Geophysics at UCLA, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 23–25, 1966.

In the past five years, the Marine Gravity Project of the Institute of Geophysics at the University of California, Los Angeles, has covered about 80,000 miles of track with a LaCoste-Romberg surface ship gravimeter on cruises in the Pacific, Atlantic, and Indian Oceans. Three areas have been surveyed in detail: the Gulf of California, 52,000 mi and 21,000 stations; California borderland, 8,500 mi and 3,400 stations; and the Indonesian archipelago, 15,000 mi and 6,000 stations. Reports on these surveys are listed and names of ships used in the surveys are tabulated.—V.S.N.

6953 **Carder, Dean S.; Gordon, D. W.; Jordan, J. N.** Analysis of surface-foci travel times: Seismol. Soc. America Bull., v. 56, no. 4, p. 815–840, illus., tables, 1966.

Regional and teleseismic P-wave traveltimes from surface focuses entail relatively fast crustal and upper mantle velocities beneath shields and slow beneath cordillera. Teleseismic arrivals from continental and oceanic sources are 2 sec earlier, on the average, than the J-B zero depth curve; in addition, an empirical surface-focus curve departs significantly from the J-B predictions at about 30° and 60° (2 1/2 to 3 sec earlier than predicted). The range from about 12° to 18° is termed the "transition zone". Given sufficient signal strength, an emergent phase arrives first; amplitudes associated with the P_t (P-teleseismic) phase dominate the longitudinal portion of recordings from the transition zone, and if noise levels are high may be interpreted as the first arrival.—D.B.V.

Carozzi, Albert V. *See* Textoris, Daniel A. 6807

Carpenter, Robert H. *See* Wedow, Helmuth. 7129

Carr, W. J. *See* Byers, F. M., Jr. 7150

7103 **Carroll, Roderick D.; Scott, James H.; Cunningham, D. R.** Elastic moduli of granitic rock from in situ measurements of seismic velocity, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C25–C28, illus., tables, 1966.

Results of measurement of compressional and shear waves and calculations of dynamic elastic constants are presented for granitic rock in two tunnels in Colorado and Nevada. Inhole recording with near-surface detonation, and surface recording with near-surface detonation were used in this study. Neither method yielded consistent shear-wave generation. This lack in consistency is attributed to conditions around the energy source and in the transmission path.—Authors' abstract

7225 **Carter, V. B.** Supplementing sample logs: Ground Water, v. 4, no. 3, p. 49–51, 1966.

In the past 20 years there has been a substantial increase in the application of electric well logging to water wells, as the industry has become aware of the benefits that can be derived. Electric logging saves time, simplifies correlation, describes the presence of salt or brackish water, and evaluates the quantity that will be produced. Some types of supplementary surveys are described briefly.—E.S.L.

7116 **Case, J. E.; Keefer, W. R.** Regional gravity survey, Wind River Basin, Wyoming, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C120–C128, illus., 1966.

Bouguer anomaly values range from about −235 mgal in the Wind River and Great Divide Basins, Wyo., to about −170 mgal over the bordering mountains. The gravity profiles reflect generally the configuration of the upper surface of the Precambrian basement complex and the relative thickness of the basin fill of upper Mesozoic and Cenozoic sedimentary rocks, which have low density. The amplitude and gradient of the gravity anomalies show that the fault zone between the Wind River Basin and the Owl Creek Mountains is high angle, and gravity anomalies and drill-

hole data show that the fault zone between the Granite Mountains and the Great Divide Basin is low angle.—Authors' abstract

7172 **Case, J. E.** Geophysical ore guides along the Colorado Mineral Belt [abs.]: Mining Eng., v. 18, no. 8, p. 33, 1966.

6780 **Case, James E.** Geophysical anomalies over Precambrian rocks, northwestern Uncompahgre Plateau, Utah and Colorado: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1423–1443, illus., 1966.

Precambrian rocks exposed in the core of the northwestern Uncompahgre Plateau of Utah and Colorado are subdivided into four units on the basis of geophysical and lithologic properties. Direct correlation of geophysical anomalies are made in areas where Precambrian rocks are exposed and extrapolations based on characteristic geophysical anomalies for these units are made for areas where these rocks are buried.—A.E.R.

6967 **Cassity, P. E.; Langenheim, R. L., Jr.** Pennsylvanian and Permian fusulinids of the Bird Spring Group from Arrow Canyon, Clark County, Nevada: Jour. Paleontology, v. 40, no. 4, p. 931–968, illus., 1966.

Fusulinids from approximately 2,500 feet of Morrowan (Pennsylvanian) through Wolfcampian (Permian) rocks are exposed in Arrow Canyon. The Morrowan and older fusulinids are noted but not described. Atokan fusulinids include *Paramillerella, Millerella, Profusulinella, and Fusulinella*; Desmoinesian fusulinids include *Wedekindellina, Fusulina, Eoschubertella, and Bartramella;* Missourian fusulinids include *Pseudofusulinella, Oketaella, and Triticites*; Virgilian fusulinids are all *Triticites*; and Wolfcampian fusulinids include *Triticites, Oketaella, Schwagerina, Pseudofusulina(?), and Pseudoschwagerina.*—R.C.D.

7111 **Cater, Fred W.** Age of the Uncompahgre uplift and Unaweep Canyon, west-central Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C86–C92, illus., 1966.

Unaweep Canyon, a wind gap that crosses the Uncompahgre Plateau, is an uplifted and deserted channel that ancient river gravels and physiographic relations indicate was occupied by the Gunnison River, rather than the Colorado River as believed by some earlier investigators. Tentative dating of fanglomerates overlying the ancient river gravels indicates the Gunnison River probably abandoned Unaweep Canyon in early Pleistocene or latest Pliocene time. Uplift of the Uncompahgre Plateau totals more than 2,000 feet, of which about 1,300 to 1,400 feet occurred after Unaweep Canyon was abandoned. Uplift probably started no earlier than mid-Pliocene. Since Unaweep Canyon has been abandoned the trunk streams in the area have downcut no more than about 100 feet.—Author's abstract

7177 **Cathcart, James B.** Economic geology of phosphate deposits in the eastern United States [abs.]: Mining Eng., v. 18, no. 8, p. 42, 1966.

7157 **Chace, Emery P.** Pleistocene Mollusca from the second terrace at San Pedro, California: San Diego Soc. Nat. History Trans., v. 14, no. 13, p. 169–172, 1966.

During construction of a high school in San Pedro, a stratum of beach rubble containing many fossil shells was exposed in an excavation. This stratum has been correlated with the second of a series of major, raised terraces of late Pleistocene age cut into the San Pedro Hills. The faunal list contains 48 pelecypods, 101 gastropods, 10 amphineurans, and 2 scaphopods.—E.S.L.

6923 **Christensen, Dean M.** The determination of the in-situ elastic properties of rock salt with a 3-dimensional velocity log, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 104–115, illus., tables, 1966.

This type logging system has been used for nearly five years in oil reconnaissance work, and more recently in studying influences of nuclear explosions underground. By combining the recorded data from 3-D velocity logs with that obtained from

density logs, the physical properties of NaCl in the Tatum Salt Dome near Hattiesburg, Miss., have been determined. A description of the 3-D system is given showing how the recorded data is correlated with amplitude and frequency of a propagated wave, followed by an analysis of a segment of a record from the Tatum survey, including an examination of the effects of temperature, pressure, and crystal orientation to show that calculated stiffness and compliance coefficients for the small dome are in good agreement with data from laboratory measurements.—G.D.C.

6819 **Christensen, Nikolas I.** Compressional wave velocities in single crystals of alkali feldspar at pressures to 10 kilobars: Jour. Geophys. Research, v. 71, no. 12, p. 3113–3116, illus., tables, 1966.

Compressional wave velocities are given for six directions in single crystals of albite and perthite to hydrostatic pressures of 10 kb. The velocities vary considerably with direction, being lowest parallel to the *a* axis; therefore the least rigid direction approximates the *a* axis. The directional rigidity of the feldspar lattice as indicated by these measurements is in agreement with the elastic adjustment of the feldspar framework to cations of different sizes.—D.B.V.

6906 **Christensen, Nikolas I.** Shear wave velocities in metamorphic rocks at pressures to 10 kilobars: Jour. Geophys. Research, v. 71, no. 14, p. 3549–3556, illus., tables, 1966.

Shear wave velocities are reported at pressures to 10 kb for a variety of metamorphic rocks. The velocities were found to vary with propagation and displacement directions. Anisotropies at high pressures correlate with preferred mineral orientation. Calculated shear velocities from modal analyses are within a few percent of the mean observed velocities. Elastic constants calculated from the shear wave velocities and previously reported compressional wave velocities are given for isotropic elastic theory. It is suggested that the elastic properties of micaceous rocks are similar to materials with hexagonal symmetry.—Author's abstract

6960 **Christiansen, Robert L.; Lipman, Peter W.** Emplacement and thermal history of a rhyolite lava flow near Fortymile Canyon, southern Nevada: Geol. Soc. America Bull., v. 77, no. 7, p. 671–684, illus., table, geol. map, 1966.

The rhyolite at Comb Peak consists of bedded tuff overlain by a lava flow that has a foliated interior with fluidal structure, enveloped by breccia. Local compaction and induration by the hot lava caused the bedded tuffs to weld near the flow contacts. Simultaneous cooling and crystallization of the hot lava and heated tuffs produce a series of zones which cross contacts between emplacement units.—A.G.

Christopher, P. A. *See* Barnard, W. M. 7167

Churkin, Michael, Jr. *See* Lenz, A. C. 6879

6854 **Clark, A. R.; Schwerdtner, W. M.** Petrofabric analysis of potash rocks, Esterhazy, Saskatchewan, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 102–121, illus., 1966.

Orientations were obtained, by means of a reflection goniometer, for 2,000 grains of sylvite and halite in sylvinite from the Esterhazy potash mines. The patterns for both halite and sylvite have orthorhombic symmetry, which corresponds with the symmetry of the gentle folds in the study area. A dynamic analysis of the fabric assumed that the evaporite beds behaved as rheids with low creep strength. The observed state of preferred orientation is considered to be due to syntectonic crystallization, and Kamb's theory of preferred crystal growth under non-hydrostatic stress is applied. The hypothetical fabric predicted by Kamb's theory agrees with the observed fabrics of halite and sylvinite. Kamb's theory not only predicts the orientation patterns, but also the equant grain shapes of both minerals and the larger grain size of sylvite.—*from* Authors' abstract

Clark, Don M. *See* Jordan, James N. 6705

6983 **Clarke, Otis M., Jr.** Geology of the Waterloo tripoli district [abs.]: Alabama Acad. Sci. Jour., v. 37, no. 1, p. 127–128, 1966.

7162 **Clarke, Otis M., Jr.** The formation of bauxite on karst topography in Eufaula district, Alabama, and Jamaica, West Indies: Econ. Geology, v. 61, no. 5, p. 903–916, illus., tables, 1966.

Bauxite deposits are formed on karst topography because the sinkholes entrap aluminous materials subject to laterization. In the Jamaican deposits, these primary aluminous materials are mainly residuum from the White Limestone Formation, but may include some volcanic ash. In the Eufaula deposits, the source materials were kaolinitic clays derived from weathering of crystalline rocks of the Piedmont. The sinkholes provide downward drainage, and deposits formed in them are protected from erosion.—W.S.W.

6794 **Clay, C. S.** Waveguides, arrays, and filters: Geophysics, v. 31, no. 3, p. 501–505, illus., 1966.

Conventional plane wave array theory does not apply to arrays in an inhomogeneous medium. In a stratified waveguide such as the ocean there are many modes of propagation, and each of them is dispersive. As expressed in normal mode formalism, the transmission between vertical arrays can be considered as a filter problem. In this paper we consider the response of the array filters to an ambient noise field, and maximize the signal-to-noise ratio for transmission in a noisy waveguide. The resulting optimum, or matched array, filter is given by the conjugate of the product of the source function and the waveguide transmission function. The response of the matched array filter is weighted with the reciprocal of the noise power in each mode and the attenuation.—Author's abstract

7071 **Cloud, William K.** Parkfield earthquakes of June 27–29, 1966, Monterey and San Luis Obispo Counties, California—Preliminary report, strong-motion records: Seismol. Soc. America Bull., v. 56, no. 4, p. 971, 1966.

An unusual feature of the Parkfield earthquakes, judging from preliminary inspection of strong-motion records and field investigations, was high acceleration of short duration (maximum, 0.5 g at one station) adjacent to surface ruptures, but remarkably little damage to man-made structures in the epicentral area.—D.B.V.

6873 **Coch, Nicholas K.; Oaks, Robert Q., Jr.** Post Miocene stratigraphy and morphology, southeastern Virginia—Friends of the Pleistocene [Eastern Group], 29th Ann. Reunion, Chesapeake, Va., 1966: [n.p.] [30] p., illus., tables, geol. map, 1966.

This itinerary provides brief descriptions of stops on a two-day field trip. It is accompanied by tables showing possible correlation and characteristics of the units, a geologic map of the inner Coastal Plain, sections, sketch maps, and sea-level charts.—E.S.L.

Coe, William R. *See* Stuckenrath, Robert, Jr. 7015

Cohenour, R. E. *See* Pratt, A. R. 6760

6917 **Cohenour, Robert E.** Great Salt Lake, Utah, and its environment, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 201–214, illus., tables, 1966.

This shallow remnant of Pleistocene Lake Bonneville has fluctuated in area more than 1,000 sq mi, with a vertical range of 20 feet and a volume change of about 21 million acre-feet. The annual direct precipitation averages 4 1/2 to 6 inches; the eastern shoreline watersheds receive 14 to 18 inches. Most inflow is via streams, springs, and ground water supplied from higher watersheds. Density of the Lake brine has ranged from 1.104 to 1.221; percentage composition is sodium – 8.4, potassium – 4.6, magnesium – 8.0, chloride – 14.7, sulfate – 1.7, and minor amounts of other ions. Calcareous bottom sediments are varied clay-silts, oolitic sands, and 100 sq mi of algal reefs. In 1959 a rock fill for the railroad created a divided

lake; by 1963 a foot of salt—730 million tons— had been deposited in the northern arm where evaporation greatly exceeds precipitation.—G.D.C.

Cok, A. E. *See* Berger, Jon. 7041

Coleman, I. *See* Low, M. J. D. 6766

Coleman, Robert G. *See* Lee, Donald E. 7120

6640 **Colquhoun, D. J.** Geomorphology of river valleys in the southeastern Atlantic Coastal Plain: Southeastern Geology, v. 7, no. 3, p. 101–109, illus., tables, 1966.

Atlantic Coastal Plain rivers in southeastern United States generally do not possess mature valley topography between valley walls and channels, an anomaly explained by two cycles and five stages. The Davisian fluvial geomorphic cycle consists of youthful and mature stages recognized by landforms, lithofacies, soils, and paleobiota. The continental submerged or submerging cycle consists of estuary, marsh, and valley head delta stages. The two cycles are independent with respect to Neogene, Pleistocene and Holocene eustatism; thus, relict stages of the merged cycle may lie in juxtaposition to any of the three stages of the submerged cycle; any submerged cycle stage may lie within relict stages of previous submerged cycles; and mature stages of the emerged may lie within relict mature stages of previous cycles. River valleys are usually interrelated stage landform sequences of eustatic fluctuations.—*from* Author's abstract

Conklin, Nancy. *See* Waring, Claude L. 7087

7141 **Connally, G. Gordon.** Multiple nested curricula and the N–6 major: Jour. Geol. Education, v. 14, no. 2, p. 54–56, 1966.

A new program with a common core for majors in geology, secondary school earth science, and elementary school earth science has been adopted at New Paltz [New York State University College] and is presented here. Requirements in geology, earth science and in related fields are included. The curriculum patterns and the underlying philosophy are discussed and the value of the program for elementary education teaching candidates is emphasized.—Author's abstract

6793 **Cooke, C. Wythe.** Emerged Quaternary shore lines in the Mississippi Embayment: Smithsonian Misc. Colln., v. 149, no. 10 (Smithsonian Inst. Pub. 4677), 41 p., illus., 1966.

Borings through the alluvial deposits of the Mississippi Embayment reveal steep-walled valleys entrenched in the underlying Tertiary and Cretaceous formations. Repeated fluctuations of sea level during the Quaternary drowned the valleys to a maximum height of 360 feet. Emerged shorelines at this, and nine lower levels, stand at the same heights as horizontal shorelines in Alabama and along the Atlantic seaboard. Alluvial deposits accumulated at tidal flats and deltas during each of these stages. At each stage the rivers meandered across tidal flats built during the preceding higher stages, and laid on them a veneer of alluvium.—E.S.L.

6759 **Cooper, Byron N.** Geology of the salt and gypsum deposits in the Saltville area, Smyth and Washington Counties, Virginia, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 11–35, illus., table, 1966.

Salt and gypsum in this area occur mostly in the Maccrady and some in the overlying Little Valley Formation of Warsaw (Mississippian) age in the great Greendale depositional syncline, in association with anhydrite and dolomite. The salt, at least in the overturned limb of the syncline occurs largely as tectonic breccia. The structure is complicated as a result of the overriding of the southeast recumbent limb by Cambrian rocks forming the sole of the Saltville Thrust; overturning of the upper limb doubled the thickness of the Maccrady in the Saltville area, enclosing older strata that had been sheared off the footwall of the fault. Salt appears to be restricted to the local vicinity of Saltville; gypsum, more widespread, is considered to be the result of shallow hydration by seeping water. Saline seepages from Palmer

Springs south of Saltville probably attracted Pleistocene mammals during Wisconsin time.—G.D.C.

7144 **Cooper, G. Arthur; Phelan, Thomas.** *Stringocephalus* in the Devonian of Indiana: Smithsonian Misc. Colln., v. 151, no. 1 (Pub. 4664), 20 p., illus., 1966.

This is the first report of this brachiopod genus in Indiana, and is of great importance as it places this important marker of the Givetian Stage in the Devonian sequence of the eastern United States. The *Stringocephalus*–*Subrensselandia*-bearing gray limestone, here named the Miami Bend Formation, underlies the Logansport Limestone and overlies the Silurian in the Logansport area. Comparison of the fossils accompanying *Stringocephalus* in Indiana with those of other formations in the United States and Canada indicates a close correlation with the Rogers City Limestone of Michigan and the Winnipegosis Formation of Manitoba. This would place *Stringocephalus* in the middle of the Cazenovia Stage in Indiana. One new species of *Subrensselandia* is described and the specimens of *Stringocephalus* are described and discussed.—E.S.L.

7024 **Corley, Nora T.** (compiler). [Arctic Institute of North America]—Bibliography of books printed before 1800: Arctic, v. 19, no. 1, p. 77–98, illus., 1966.

Included in the Library of the Arctic Institute of North America are many books published before 1800; some are rare, some valuable, all interesting. This listing includes brief annotations in various languages, and vital dates of authors.—G.D.C.

6758 **Cornwall, Henry R.** Nickel deposits of North America: U.S. Geol. Survey Bull. 1223, 62 p., illus., tables, 1966.

Nickel occurs mainly in sulfide deposits consisting of pyrrhotite, pentlandite, and chalcopyrite in or associated with norite and peridotite, and in laterites formed by weathering of peridotite and serpentine. Canada has the largest nickel sulfide deposits in the world at Sudbury, and Thompson, and also a number of smaller similar deposits. In the United States several nickeliferous laterites, one of which is being mined, occur along the west coast. There are also a number of nickel–copper sulfide, and complex nickel–copper–cobalt hydrothermal deposts in the United States, but they are too low grade or too small to be minable.—H.R.C.

6948 **Coursaget, J.; LeRun, J.** Gif-sur-Yvette natural radiocarbon measurements I: Radiocarbon, v. 8, p. 128–141, 1966.

Radiocarbon dates are listed from the Radiocarbon Laboratory at Gif-sur-Yvette from 1958 to March 1963; this laboratory has been replaced by the Gif laboratory (ibid., p. 74–95). Measurements were made on archeologic samples from France, Asia, Africa, Brazil, Guatemala, Costa Rica, and Peru; and on geologic samples from France.—M.C.M.

Cowan, G. R. *See* Balchan, A. S. 6713

6763 **Cowan, J. C.; Lee, C. R.** The geology of the Strathcona ore deposit, Sudbury district, Ontario [abs.]: Econ. Geology, v. 61, no. 4, p. 801–802, 1966.

6638 **Craig, J. R.; Kullerud, G.** Phase relations in the Cu–Fe–Ni–S system above 400°C [abs.]: Econ. Geology, v. 61, no. 4, p. 804–805, 1966.

Crain, E. R. *See* Alger, R. P. 6848

7013 **Crane, H. R.; Griffin, James B.** University of Michigan radiocarbon dates XI: Radiocarbon, v. 8, p. 256–285, 1966.

Radiocarbon dates obtained since the compilation of List X in December 1964 are given for geologic samples from Michigan and Greenland; and for archeologic samples from the United States, Canada, Mexico, Guatemala, and Egypt.—M.C.M.

6647 **Crowell, John C.; Hope, Roger A.; Kahle, James E.; Ovenshine, A. Thomas; Sams, Richard H.** Deep-water sedimentary structures, Pliocene Pico Formation, Santa

Paula Creek, Ventura basin, California: California Div. Mines and Geology Spec. Rept. 89, 40 p., illus., tables, 1966.

At Santa Paula Creek, ideal exposures of the middle part of the Pico Formation, deposited in marine waters at least 270 m deep, provide an unusual opportunity to examine in three dimensions the many sedimentary structures, presumably the result of turbidity currents. Reconstructed mechanics of sedimentation indicate flow of current primarily to the west, with great variability, but contributing to the longitudinal infilling of a broad and nearly level trough with steep margins rising to an irregular shoreline with an approximate east-west trend. Sand and mud and gravel moved downslope within underflows that acquired energy in flowing down the trough margin. Much debris probably debauched from submarine canyons. The complex underflows, weaving from side to side, could move a bed load by traction; stronger currents eroded and disturbed the sea floor.—G.D.C.

Cunningham, D. R. *See* Carroll, Roderick D. 7103

7067 **Curry, Robert R.** Observation of alpine mudflows in the Tenmile Range, central Colorado: Geol. Soc. America Bull., v. 77, no. 7, p. 771–776, illus., 1966.

On August 18, 1961, at the head of Mayflower Gulch in the Tenmile Range of central Colorado, after a 24-hour rainfall of 24.5 cm a series of alpine mudflows was observed. The flows occurred as a series of pulses which moved at a maximum observed velocity of 980 m/min (53 feet/sec) over and through saturated talus on slopes as steep as 41°. Samples of the matrix of the moving debris had a density of 2.53 g/cm^3, 11 percent silt and clay, and less than 10 percent water. Viscosity of this material calculated from flow rates is roughly 3×10^4 poises. Four successive ancient mudflow deposits were recognized at the site of the largest mudflow. Lichenometric analysis indicates that they occurred about once every 150–400 years.—Author's abstract

Curtin, G. C. *See* Moore, William J. 7083

6882 **Curtis, Willie R.** Response of springflow to some climatic variables in southwestern Wisconsin: Water Resources Research, v. 2, no. 2, p. 311–314, illus., 1966.

Field investigations show the relationships of springflow to some climatic variables in the Driftless Area of southwestern Wisconsin. Observations near La Crosse indicate that springflow fluctuates in much the same manner as recharge to ground water. In addition, short-period fluctuations in springflow are caused by changes in barometric pressure. This influence is more pronounced during the dormant season. A good correlation was found between springflow and the base flow of Knapp Creek; the data indicate that groundwater makes up 60 to 75 percent of the streamflow in the region.—G.D.C.

6859 **Czamanske, Gerald K.; Hower, John; Millard, Richard C.** Non-proportional, non-linear results from X-ray emission techniques involving moderate-dilution rock fusion: Geochim. et Cosmochim. Acta, v. 30, no. 8, p. 745–756, illus., tables, 1966.

Five "standards", made by mixing standard rock samples G-1 and W-1 in various proportions, were fused with lithium tetraborate in a ratio of 35:65 and analyzed for Si, Al, Fe, Ca, K, Ti, and Mn by X-ray emission techniques. Elemental Kα-radiation intensities are not proportional to concentration, and calibration curves are thus nonlinear over the ranges of composition represented. Computer-aided calculations confirm that large matrix effects exist for samples prepared by this fusion method and afford means for adjusting raw data.—Authors' abstract

6715 **Damon, Paul E.; Long, Austin; Grey, Donald C.** Fluctuation of atmospheric C^{14} during the last six millennia, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 415–428, illus., tables [1966?].

Techniques of the C–14 age method for dendrochronologically dated woods are given, and correlation with climate discussed. Implications relative to dating include the contraction of the C–14 time scale during the first four millennia B.C., and the fact that C–14 dates are non–unique within a certain range of time. Three hypotheses for the fluctuation of the C–14 content of the atmosphere are considered: oscillations in storage and release of CO_2 from the biosphere, alternating periods of faster and slower mixing of the oceans, and variations in cosmic–ray intensity.—E.S.L.

Damon, Paul E. *See* Haynes, C. Vance, Jr. 6985

Dance, S. Peter. *See* Olsson, Axel A. 6940

6783 **Davies, Raymond.** Concentration of mica by water flotation: Geol. Soc. America Bull., v. 77, no. 6, p. 661–662, illus., 1966.

A simple technique for the rapid recovery of mica concentrates has been devised. No heavy liquids are used, so this eliminates a possible source of contamination in age determination or trace–element analyses.—Author's abstract

6900 **Davis, B. T. C.; Boyd, F. R.** The join $Mg_2Si_2O_6$–$CaMgSi_2O_6$ at 30 kilobars pressure and its application to pyroxenes from kimberlites: Jour. Geophys. Research, v. 71, no. 14, p. 3567–3576, illus., tables, 1966.

At 30 kb pressure the join $Mg_2Si_2O_6$–$CaMgSi_2O_6$ is binary. Details are described. Ca–rich and Mg–rich pyroxene pairs from peridotite nodules in kimberlites can be treated in first approximation as phases in the system $Mg_2Si_2O_6$–$CaMgSi_2O_6$. Seven modern analyses of Ca–rich pyroxenes from such nodules show a range of solid solution corresponding to a range of equilibrium temperatures of about 950–1,300°C. It is not yet certain whether this range is primary or whether some exsolution occurred during eruption.—D.B.V.

6733 **Davis, E. Mott.** Interdisciplinary appraisal of radiocarbon dates in archeology, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF–650652, p. 294–303 [1966?].

It is emphasized that in applying the C–14 dating techniques to problems in archeology the archeologist and radiochemist must work jointly. A sizeable group of samples should be run which has been selected with particular problems in mind. It must be remembered that a radiocarbon assay is not a date but a preliminary estimate, and that dates are derived through mutual appraisal by the radiochemist and archeologists of a series of assays.—V.S.N.

Davis, E. Mott. *See* Pearson, F. J., Jr. 7017

Davis, Kenneth S. *See* Leopold, Luna B. 6702

7155 **Davis, R. W.** Availability of ground water in the Fancy Farm quadrangle, Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–169, scale 1:24,000, section, text, 1966.

Sufficient supplies of ground water for domestic and most public and industrial needs are available in the Fancy Farm quadrangle. Most wells are less than 200 feet deep in Eocene sand; they yield about 250 gpm and quality of ground water is good. Present withdrawals are insignificant compared to the large amount of water in storage.—M.C.M.

7055 **Davis, S. N.; Moore, G. W.; McClurg, D. R.** Semidiurnal movement along a bedrock joint in Wool Hollow Cave, California—Preliminary report [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 91, 1966.

7038 **Deal, Dwight E.** Mud stalagmites in Jewel Cave, South Dakota: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 106–107, illus., 1966.

Mud stalagmites five to eight mm in diameter and 40 to 50 mm high occur in Jewel Cave, South Dakota. They are composed of rounded quartz grains in a clay matrix. A semi-liquid flow of mud and sand dripped from calcite crystals overhead to form stalagmites.—Author's abstract

7056 **Deal, Dwight E.** Naturally polished pebbles from Black Hills caves: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 104–105, illus., 1966.

"Cave pearls" that may have been naturally tumble-polished are found in Bethlehem and Jewel Caves, South Dakota. They are formed from fragments of limestone, calcite, other speleothems, and chert(?). Due to the questionable identification of the chert fragments a solutional origin cannot completely be ruled out.—Author's abstract

7025 **Debano, L. F.; Krammes, J. S.** Water repellent soils and their relation to wildfire temperatures: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 2, p. 14–19, illus., 1966.

A naturally occurring water resistant soil was exposed to different burning times and temperatures after which the soil samples were tested for non-wettability. The less intense treatments produced an extremely non-wettable condition. Temperatures of 800 and 900 degrees applied for 20 minutes completely destroyed the non-wettable property. Heat treatments within the realm of soil temperatures existing during wildfires were capable of producing the extreme non wettable condition. The increased surface runoff and erosion from burned southern California watersheds could be the result of this relationship.—Authors' abstract

6914 **deBremaecker, J. C.; Godson, Richard H.; Watkins, Joel S.** Attenuation measurements in the field: Geophysics, v. 31, no. 3, p. 562–569, illus., tables, 1966.

The amplitudes of P-head waves were measured in an aa flow, on unconsolidated cinders, and on compact limestone on sites north of Flagstaff, Ariz. Data are satisfied by an equation for amplitude in terms of distance, attenuation coefficient for P waves, frequency, and P-wave velocity. The assumption of a complex shear modulus, but a real λ, furnishes an adequate explanation of published and new data on attenuation of P wave with distance; it also explains the greater attenuation of S waves and relates attenuations to relative velocities of P and S.—D.B.V.

Decker, E. R. *See* Walsh, J. B. 6816

7073 **deGraaff-Hunter, J.** The anomalies of potential Ng at surface points of regions gravitationally surveyed, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 78–80, 1966.

Stokes' method for finding the potential anomalies on the geoid benefits from the use of a well-chosen reference system based on a close-fitting Earth model (stated or implied) with minimal anomalies of g. A mode of determination of *partial* potential anomalies (from which lower harmonics are absent) for the case of incomplete gravity data coverage of the globe is suggested.—Author's abstract

7082 **Delevaux, M. H.; Pierce, A. P.; Antweiler, J. C.** New isotopic measurements of Colorado ore leads, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C178–C186, illus., tables, 1966.

Seventy-six mass spectrometric analyses were made by electron bombardment of PbI_2, during which 36 runs on a lead reference sample, GS/4, showed standard deviations from the mean for isotopic ratios of 206/204, 206/207, and 206/208 of 0.21 percent, 0.09 percent, and 0.11 percent, respectively. Ten samples were mass spectrometrically analyzed by thermal emission of PbS, during which 18 runs on the same reference sample showed percent standard deviations in the three ratios of 0.12 percent, 0.06 percent, and 0.12 percent, respectively. In contrast, the range in natural variations was many times greater: from the Yule marble quarry, Gunnison County, the isotopic ratios were 206/204 = 24.15, 207/204 = 16.24, and

208/204=41.62, compared to 15.76, 15.35, and 35.42 in a sample from the High Lonesome mine in Grand County.—Authors' abstract

Delevaux, M. H. *See* Heyl, A. V. 7121

Dennis, J. G. *See* Kirchmayer, Martin. 6961

7043 **Deutsch, Ernst R.** The rock magnetic evidence for continental drift, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 28–52, illus., tables, 1966.

Geomagnetism and continental drift may be unpredictably linked. Magnetic data from Paleozoic and younger rocks, plotted on a projection of the present Northern Hemisphere, support occurrence of continental drift since the Precambrian. Precambrian evidence is inadequate, although pole positions relative to North America and Great Britain may be attributed to a widening gap between the two land masses. Polar wandering and global expansion are alternatives to drift, considered with it in pairwise combinations. Velocity estimates of horizontal displacement must be carefully integrated with absolute age determinations. Easternmost Canada is a potentially fertile field for paleomagnetic application to its tectonic or structural problems.—G.D.C.

6817 **Dews, John R.; Newbury, Ray S.** The isotopic composition of silver in the Canyon Diablo meteorite: Jour. Geophys. Research, v. 71, no. 12, p. 3069–3081, illus., tables, 1966.

Results of mass spectrometric measurements of the isotopic composition of 5 samples of silver isolated from the Canyon Diablo iron meteorite and 18 samples of terrestrial silver are presented. The meteoritic and terrestrial Ag–107/Ag–109 ratios are identical to within one percent. The silver content of Canyon Diablo is 58 ppb. It was not possible to confirm a previous report of a four percent excess of Ag–107 in Canyon Diablo.—D.B.V.

6665 **Dews, Jon Robert.** A search for isotopic anomalies in silver and lithium from meteorites [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7375, 1966.

6701 **Dibblee, T. W., Jr.; Bassett, A. M.** Geologic map of the Cady Mountains quadrangle, San Bernardino County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I–467, scale 1:62,500, sections, separate text, 1966.

The text describes the Cenozoic sedimentary and volcanic rocks, and Mesozoic plutonic, hypabyssal, and metavolcanic igneous rocks of the Cady Mountains quadrangle. Mines and prospects are listed for gold–copper, manganese, strontium, barite, fluorite, clay, agate and jasper, travertine, and radioactive minerals.—M.C.M.

7063 **Dickinson, William R.** Structural relationships of San Andreas fault system, Cholame Valley and Castle Mountain Range, California: Geol. Soc. America Bull., v. 77, no. 7, p. 707–725, illus., geol. map, 1966.

Long–continued strike–slip movement on the San Andreas fault zone is suggested by structural relations in the vicinity of Cholame Valley. Four structural belts are recognizable: a narrow rift belt, a wider fault zone, a zone of superimposed folds and sinuous faults, a zone of open folds. Tectonic breccia of Franciscan rock is separated from Late Mesozoic strata more than 10,000 feet thick by a folded thrust. More than 5,000 feet of marine Tertiary strata are unconformable on the older rocks and are overlain by about 2,500 feet of nonmarine Pliocene and Pleistocene strata. Surface structures are attributed to raft tectonics wherein near–surface rocks are deformed as they are dragged by moving undermasses that may be flowing subparallel to the San Andreas fault.—J.G.V.

Dickson, F. W. *See* Bowser, C. J. 6853

Dickson, F. W. *See* Weissberg, B. G. 6862

6732 **Dimbleby, G. W.** Potentialities of radiocarbon dating in the connected fields of soil science and archeology, *in* Internat. Conf. Radiocarbon and Tritium Dating,

6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 287-293 [1966?].

Soil organic material is not ideal for radiocarbon dating, but the few determinations that have been made are of such interest that it seems worthwhile to survey the potential applications. To do this it is necessary to understand the processes of soil-profile development, which are considered under three headings. In the normal continuously developing profile, both base-rich and nonbasic soils, and discrepancies of C-14 dates with pollen analysis are discussed. In compound soils and soils buried under various types of cover, C-14 dating of the stages would aid in the interpretation.—E.S.L.

7122 **Dimroth, Erich.** Deformation in the Grenville province between Gatineau and Petite Nation rivers, Quebec: Neues Jahrb. Mineralogie Abh., v. 105, no. 1, p. 93-109, illus., 1966.

Three stages of folding are represented in the area between the Gatineau and Petite Nation Rivers in Quebec. The first stage produced northeast-trending recumbent folds, the second northeast-trending open folds, and superposition of north-south-trending folds in the third stage produced domes and basins. Three phases of granitization are represented, one preceding the first folding (granites), the second (gabbros) preceding the third folding, and the third (granites) following the third folding.—D.B.V.

Dingman, R. J. *See* Morgan, C. O. 7206

7085 **Dinnin, Joseph I.; Worthing, Helen W.** Determination of microquantities of mercury in sulfide ores by Penfield tube-dithizone and semiquantitative spectrographic methods, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C220-C223, tables, 1966.

Microquantities of mercury can be determined by either of two methods described. In the chemical method, mercury is volatilized in a Penfield tube, and the separated mercury dissolved and determined colorimetrically with dithizone. In the semiquantitative spectrographic method, mercury is volatilized using a deep electrode crater and a short exposure time. Both methods are applied to the analysis of mixtures of cinnabar and sphalerite.—Authors' abstract

6918 **Dombrowski, H. J.** Geological problems in the question of living bacteria in Paleozoic salt deposits, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 215-220, 1966.

Inclusions in micro-cuts of salts have been identified as bacteria and bacterial spores; the question as to their present vitality motivated further research. Rock salt specimens of evident primary genesis were chosen from German Zechstein, Nova Scotia Carboniferous, Saskatchewan Middle Devonian, New York Silurian, and Siberian Lower Cambrian strata. The geological, petrological and mineralogical character, important in determining the age of these bacteria, is described for each salt rock and the salts. Permian gymnospores were found in the Zechstein salt from which living bacteria were isolated. Evidences of recrystallization and diagenesis were seen in various specimens, but their compact crystal structure protected primary trapped bacteria from effects of pressure or contamination to preserve some living in the center of salt crystals.—G.D.C.

Dort, Wakefield, Jr. *See* Siegel, Frederic R. 7159

7203 **Douze, Eduard J.** Noise attenuation in shallow holes: Seismol. Soc. America Bull., v. 56, no. 3, p. 619-632, illus., tables, 1966.

Significant improvements in the performance of short-period seismograph recordings are sometimes obtained in shallow holes (<300 m). Wind noise attenuates rapidly with depth and becomes insignificant at depths of 60 m or less. In the presence of low-velocity weathered layers, the normal background noise decays rapidly with depth and significant improvements in signal-to-noise ratios are obtained. In the absence of a low-velocity zone, only a small attenuation in the

background noise level is obtained. Little or no wind noise is converted into traveling seismic waves.—Author's abstract

6720 **Dreimanis, Aleksis; Vogel, J. C.** Reevaluation of the length of the Port Talbot Interstadial in the Lake Erie Region, Canada, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 720–729, illus., tables [1966?].

It is concluded from new radiocarbon dates, restudy of the Port Talbot Interstadial type section, Ontario, and comparison with other late Pleistocene deposits that the Southwold Drift, previously interpreted as 44,000 yr old, is the basal member of the Catfish Creek Drift, and less than 25,000 yr old; the Port Talbot Interstadial is probably several thousand years longer than previously assumed; termination of this Interstadial was either 28,000 or 24,000 yr B.P. in this region, depending on whether the Plum Point is included; and the Port Talbot Interstadial may be correlated with other long cool intervals. Three interpretations of a Port Talbot section are tabulated, and an appendix gives C-14 dates of probable Port Talbot and Plum Point Interstadial samples.—E.S.L.

Dresher, W. H. *See* Naumann, A. W. 6995

7075 **Durbin, William P., Jr.** Geophysical correlations, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 85–88, 1966.

Where gravity data are insufficient for geodetic purposes and actual observations are not practical, nonconventional methods must be used. This paper proposes several geophysical approaches toward partial solution of the problem. The utilization of geologic, seismic, crustal, and magnetic information in a gravimetrically unsurveyed area will provide an approximate anomaly which can either stand alone or be used in conjunction with statistical methods.—Author's abstract

Durisek, E. Jane. *See* Roberson, Herman E. 6689

6905 **Durney, B.** Equilibrium configurations between density and topographic surface irregularities in a purely elastic earth model: Jour. Geophys. Research, v. 71, no. 12, p. 3029–3032, illus., 1966.

A two-dimensional purely elastic Earth model is used to study elastic equilibrium configurations between density and topographic surface irregularities (mountains). Given a density deficiency $\delta\rho(x,y)$, the shape of the mountain in equilibrium with $\delta\rho\,(x,y)$ is determined by specifying that the vertical displacements due both to the mountain and $\delta\rho(x,y)$ vanish at the surface. The compression due to density irregularities is evaluated and numerical examples are given.—Author's abstract

6947 **Dyck, W.; Lowdon, J. A.; Fyles, J. G.; Blake, W., Jr.** Geological Survey of Canada radiocarbon dates V: Radiocarbon, v. 8, p. 96–127, tables, 1966.

Radiocarbon dates compiled from August 1, 1964 to October 1, 1965 are given for geologic samples from eastern and western Canada, and the mainland and Arctic Archipelago of northern Canada.—M.C.M.

6866 **Eakin, Thomas E.** A regional interbasin groundwater system in the White River area, southeastern Nevada: Water Resources Research, v. 2, no. 2, p. 251–271, illus., tables, 1966.

A ground water system including 13 valleys in this area is identified on the basis of preliminary appraisals of recharge and discharge, hydrogeology, and chemical character of the spring water. Paleozoic carbonate rocks are the means of transmitting ground water in the region; estimates of recharge and discharge show wide discrepancies in individual valleys, but hydrologic balance within the region; the discharge of the lowest of the three principal spring groups is highly uniform, consistent with a large regional supply. The relation between this regional system and others in eastern and southern Nevada is under study.—G.D.C.

6959 **Eardley, A. J.** Rates of denudation in the high plateaus of southwestern Utah: Geol. Soc. America Bull., v. 77, no. 7, p. 777–779, illus., 1966.

From two C–14 dates on wood from lake sediments that accumulated behind landslide dams in deep canyons of Zion National Park, Utah, the rate of denudation of the related drainage basin is found to be about 33 inches per 1,000 years. Another denudation rate in the headward drainage of Coal Creek, just north of Cedar Breaks National Monument, was found to be about 17 inches per 1,000 years, based on ages of bristlecone pine trees and the amount of their root exposure. These rates of denudation compare to an average denudation rate of 6.5 inches per 1,000 years in the Colorado River watershed.—J.P.A.

7126 **Ebbley, Norman.** Silver–gold occurrences, Silver Peak, Nev. [abs.]: Mining Eng., v. 18, no. 8, p. 33, 1966.

6772 **ElBaz, Farouk El Sayed.** Petrology and mineralogy of certain portions of the Fredericktown deposits, Missouri—A case study of ore genesis in a layered sulphide deposit [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7256–7257, 1966.

6839 **Elias, Maxim K.** Remarks on *Fusulina insolita* Thompson: Oklahoma Geology Notes, v. 26, no. 4, p. 97–98, 1966.

The species *Fusulina insolita* was introduced by Thompson (1948) on a sample collected by him from near the top of the Pennsylvanian Cuchillo Negro Limestone in New Mexico. Later identifications of this and related species in Arizona and Oklahoma are compared in connection with the evolutionary trend toward greater intensity of septal folding. A quantitative method for the measurement of this intensity is suggested, which would probably lead to differentiation of more than one subgenus or genus in *Fusulina*. A biometric study using this method would help to clarify the concept of development of *Fusulina* from *Fusulinella* and relation of *Fusulina* to the Atokan–Desmoinesian boundary.—E.S.L.

6686 **Ellison, Samuel P., Jr.** A philosophy of geological education: Jour. Geol. Education, v. 14, no. 1, p. 3–6, 1966.

This philosophy of geology teaching advocates emphasis on unique subject material, such as concepts of time, of life, of resources, and of natural equilibrium, reconstruction of geological events, and possibility of alternate answers as a pattern of thinking; a close student–teacher partnership; a research and publication effort oriented to benefit students and people; and emphasis on service to society. The impact of teachers and associates on the image of geology in young minds was recognized in the author's own educational experience.—G.D.C.

6834 **Elsasser, Walter M.** Thermal structure of the upper mantle and convection, *in* Advances in Earth science—Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 461–502, illus., 1966.

Oceanic rises and ridges as evidences of rising mantle material revive an old interest in continental drift. The fundamental role of mechanical instability in the process of mantle motions is examined; a principle of diminishing symmetry is proposed. Theories of convection and of orogeny are reviewed. In the variability in observed phenomena three empirical regularities need at least semiquantitative explanation: a double maximum of elevations, one for the continents near sea level and one for the ocean bottoms near –5km; rough equality of average heat flow over continents and ocean bottoms; and rather exact centering of certain ocean ridges, especially in the Atlantic between continental margins. The long persistence of orogenic belts is an effect of thermal instability of the mantle, mixed with chemical effects. Extremely superadiabatic thermal gradients are an assumed steady-state feature of the upper mantle.—G.D.C.

6811 **Elson, John A.** Early discoverers—[Pt.] 13, Till–stone orientation, Henry Youle Hind (1823–1908): Jour. Glaciology, v. 6, no. 44, p. 303–306, illus., 1966.

Hind's theory of till–stone orientation is summarized. Reference is made to his paper "On the blue clay of Toronto" presented orally before the Canadian Institute

in 1856 and reiterated in a published paper in 1859, "A preliminary and general report on the Assiniboine and Saskatchewan exploring expedition". A brief summary is given also of Hind's career as a geologist in Canada in the latter half of the 19th century.—V.S.N.

Elving, Philip J. *See* Kolthoff, I. M. 6981

6750 **Emery, C. L.** An experiment to define the strain redistribution at surface caused by a growing cavity at depth [abs.], *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 103, 1966.

6696 **Empson, F. M.; Boegly, W. J., Jr.; Bradshaw, R. L.; McClain, W. C.; Parker, F. L.; Schaffer, W. F., Jr.** Demonstration of disposal of high-level radioactive solids in salt, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 432–443, illus., 1966.

Use of salt formations as a disposal site has been under investigation since 1956. Plans are presented for a demonstration of the disposal of solid radioactive wastes in salt of Permian age in the Hutchinson Member of the Wellington Formation, using the inactive mine of the Carey Salt Company at Lyons, Kans. Objectives of this Project Salt Vault include: determination of stability of salt under influence of heat and radiation, and information on creep and plastic flow of salt needed for the design of an actual disposal facility.—G.D.C.

7164 **Epstein, B.; Lomnitz, Cinna.** A model for the occurrence of large earthquakes: Nature, v. 211, no. 5052, p. 954–956, illus., tables, 1966.

A probability model is outlined which seems to provide a basis for predicting the occurrence of largest earthquake magnitudes over time. Calculations based on this model have been carried out for California earthquakes in the period 1932–62. Computations of the expected number of earthquakes per year (Ny) and mean return period (Ty) for shocks of $M \geq y$ show that for M = 7, Ny = 0.076 and Ty = 13.2 yr; for M = 8, Ny = 0.010 and Ty = 100.0 yr; and for M = 9, Ny = 0.0014 and Ty = 720 yr.—D.B.V.

6896 **Erickson, R. L.; VanSickle, G. H.; Nakagawa, H. M.; McCarthy, J. H., Jr.; Leong, K. W.** Gold geochemical anomaly in the Cortez district, Nevada: U.S. Geol. Survey Circ. 534, 9 p., illus., table, 1966.

An area in the Cortez district, Nevada, previously established to be anomalous in arsenic, antimony, and tungsten has been found to be anomalous also in mercury and gold. Samples from narrow quartz veins, calcite veins, and shear zones in partially silicified limestone in the lower plate of the Roberts thrust fault (Cortez window) contain as much as 3.4 ounces gold per ton. The richest samples are from an outcrop, about 100 feet long, surrounded by gravels. Their economic significance is yet to be established.—Authors' abstract

6680 **Eugster, H. P.** Deposition of trona [abs.], *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 165, 1966.

Eugster, H. P. *See* Hardie, L. A. 6681

6728 **Eugster, Hans P.** Sodium carbonate-bicarbonate minerals as indicators of $P_{carbon\ dioxide}$: Jour. Geophys. Research, v. 71, no. 14, p. 3369–3377, illus., tables, 1966.

The CO_2 content of a gas phase equilibrated with the assemblages nahcolite+trona+solution, nahcolite+trona+halite+solution, and trona+thermonatrite+solution has been determined at 1 atm pressure. Application of the results to the Eocene Green River Formation and Pleistocene Searles Lake deposits indicates that the CO_2 contents of the paleoatmospheres must have been between 10 times and 1/10 of the CO_2 content of today's atmosphere.—D.B.V.

7047 **Evans, B. W.; Strens, R. G. J.** Zinc mica from Franklin Furnace, New Jersey: Nature, v. 211, no. 5049, p. 619, tables, 1966.

Analytical, optical, and X-ray data are reported for two samples of a dark mica, occurring in platy crystals in hancockite-bearing rocks from Franklin Furnace, New Jersey, which contains 19.8 percent ZnO and 12.5 percent MnO, corresponding to about 40 and 30 percent, respectively, of the Zn and Mn end-members.—D.B.V.

6865 **Evans, S.; Robin, G. de Q.** Glacier depth-sounding from the air: Nature, v. 210, no. 5039, p. 883-885, illus., 1966.

Airborne very-high-frequency radio echo apparatus, slightly improved over that used initially to sound the depth of the Greenland ice sheet, was used over some major glaciers and several crossings of ice caps on northern Ellesmere Island and over the McGill ice cap and Thomson Glacier on Axel Heiberg Island. Examples of some records obtained over different ice conditions are reproduced and discussed.—D.B.V.

7030 **Ewers, Ralph O.** Bedding plane anastomoses and their relation to cavern passages [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 92, 1966.

Ewing, Maurice. *See* Talwani, Manik. 6714

Fairhall, A. W. *See* Schell, William R. 6910

7007 **Fairhall, A. W.; Schell, W. R.; Young, J. A.** Radiocarbon dating at the University of Washington III: Radiocarbon, v. 8, p. 498-506, 1966.

Radiocarbon measurements made since 1962 are given for geologic samples from British Columbia, Washington, and Alaska; and archeologic samples from Egypt, Pakistan, British Columbia, and Washington.—M.C.M.

6891 **Fang, J. H.; Bloss, F. Donald.** X-ray diffraction tables: Carbondale, Ill., Southern Illinois Univ. Press, unpaged, 1966.

The tables cover the determination of d, $\sin^2\theta$, or Q for 0.01° intervals of 2θ for the wavelengths Ka, Ka_1, Ka_2, and Kβ of copper, iron, molybdenum, and chromium radiations for La_1 of tungsten.—Authors' abstract

6945 **Farnham, R. S.; Grubich, Donald N.** Peat resources of Minnesota—Rept. of Inventory No. 3, Red Lake bog, Beltrami County, Minnesota: St. Paul, Minn., Office Iron Range Resources and Rehabilitation, 24 p., illus., tables, 1966.

The Red Lake Sphagnum peat bog, located in one of the largest continuous peat land regions of the world, is a raised area of more than 3,500 acres with steep slopes that create good natural drainage; thickness ranges from five to ten feet. A radiocarbon analysis taken from the bottom of the strata at the eight to nine ft level was dated at 2,250±120 years B.P. This represents a growth rate of one ft in 250 years, a fast rate of accumulation. Analyses of peat from 80 sites are tabulated.—M.C.M.

6980 **Farrah, G. H.; Moss, M. L.** Aluminum, *in* Treatise on analytical chemistry—Pt. 2, Analytical chemistry of inorganic and organic compounds, V. 4, Sec. A: New York, Interscience Publishers, p. 367-439, illus., tables, 1966.

Although not occurring naturally as a free metal, aluminum is the most widely distributed metallic element in nature, as summarized in this chapter; typical minerals are tabulated. The physical and chemical properties of aluminum are briefly described, including electrochemical reactions. Selective separation methods are discussed, and determination procedures are given for various methods and in specific materials, including the analysis of bauxite.—G.D.C.

6984 **Ferguson, C. C.; Stearns, R. G.** Consistent geologic map contacts and isopleth patterns of the Upper Mississippian in the Beans Creek area, Tennessee [abs.]: Alabama Acad. Sci. Jour., v. 37, no. 1, p. 127, 1966.

Fidler, R. E. *See* Norris, S. E. 7205

Fiedelman, Howard W. *See* Andelfinger, George F. 6850

Fiedelman, Howard W. *See* Shuman, A. Cornwell. 6922

7184 **Field, Cyrus W.** Sulfur isotope abundance data, Bingham district, Utah: Econ. Geology, v. 61, no. 5, p. 850–871, illus., tables, 1966.

Range in isotopic composition is small, with a mean close to that for meteorite sulfur, suggesting a magmatic hydrothermal origin and derivation from a deep seated source, perhaps within the mantle. Pyrite samples show the entire range of compositions, from S-32/S-34 ratios of 22.151 to 22.306. Vein pyrite is richer in S-34 than disseminated pyrite. Sulfide minerals of individual samples show increasing mean S32/S34 ratios in the sequence molybdenite–pyrite–chalocopyrite–bornite. Weak zonation is shown by progressive depletion of S-34 outward from the central zone of the district.—W.S.W.

7003 **Fischer, Karl B.** A further refinement of the crystal structure of cummingtonite, $(Mg,Fe)_7(Si_4O_{11})_2(OH)_2$: Am. Mineralogist, v. 51, nos. 5–6, p. 814–818, tables, 1966.

By refining the atomic scattering power of each of the four cation sites, M_1 through M_4, of the crystal structure of cummingtonite, the distributions of magnesium and ferrous iron over these sites were determined to be: M_1, 84 percent Mg and 16 percent Fe; M_2, 95 percent Mg and 5 percent Fe; M_3, 84 percent Mg and 16 percent Fe; M_4, 13 percent Mg and 87 percent Fe. Ghose's original data (1961) were used for this work. The results demonstrate the usefulness of the f-refinement technique for the evaluation of mixed populations for more than one equipoint.—Author's abstract

7018 **Fisher, D. Jerome.** Palermo "hühnerkobelite" is alluaudite: Am. Mineralogist, v. 51, nos. 5–6, p. 935–939, tables, 1966.

Fisher prefers to assign the mineral of a series isomorphous with alluaudite the mineral name alluaudite rather than denote the cation content and valence by naming of end members. D-spacings from two alluaudites by X-ray diffractometer techniques are included in the discussion, but not their composition.—M.L.L.

6723 **Fisher, David E.** The origin of meteorites—Space erosion and cosmic radiation ages: Jour. Geophys. Research, v. 71, no. 13, p. 3251–3259, illus., 1966.

It is suggested that the erosion of chondritic meteorites by interplanetary dust is a mechanism that can account satisfactorily for the cutoff in radiation ages at 55×10^6 years, if the meteorites have an asteroidal origin. Spectrums of chondritic radiation ages are calculated, based on a model involving continuous meteorite creation in the asteroidal belt and coupled with several erosion rates, and are compared to experimental results. The calculated and experimental spectrums are in good agreement.—Author's abstract

Flinn, E. A. *See* Archambeau, C. B. 6711

Foster, M. R. *See* Harvey, J. R. 6916

Fredriksson, Kurt. *See* Olsen, Edward. 6925

7199 **Freedman, Helen W.** A statistical discussion of Pn residuals from explosions: Seismol. Soc. America Bull., v. 56, no. 3, p. 677–695, illus., tables, 1966.

The problem of the statistical treatment of large numbers of Pn residuals is considered, using traveltimes to stations in California and Nevada for 43 explosions in Nevada. Techniques of data selection and weighting of observations are developed to estimate the distribution of residuals and estimate station adjustments to Jeffreys–Bullen traveltimes. A new simple method of estimating the mean of a normal population from a truncated sample is given. Approximate analysis of

variance shows a significant variation from one explosion to another in mean Pn traveltimes; shortest and most reliable Pn traveltimes were obtained for large magnitude explosions detonated in metamorphic rock. Station adjustments also differed significantly (0.0 sec at Fresno to −1.3 sec at Calistoga).—D.B.V.

Frost, Irving C. *See* Swanson, Vernon E. 7196

Fuerstenau, D. W. *See* Burns, R. G. 7032

Fyles, J. G. *See* Dyck, W. 6947

6782 **Gammon, Sam W.; Muse, W. Ralph.** Water-level data from observation wells in the Southern High Plains of Texas: Texas Water Devel. Board Rept. 21, 537 p., illus., tables, 1966.

Water-level records from 29 counties in the southern High Plains of Texas are presented, representing an area of 28,316 sq mi. Data are from wells located principally in areas of large withdrawals of ground water for irrigation and public use. Records and related information are presented in county tabulations, location maps, and hydrographs.—M.C.M.

7128 **Gardner, Charles H.** Stability of open pit slopes in the Florida phosphate district [abs.]: Mining Eng., v. 18, no. 8, p. 41, 1966.

7127 **Gardner, Richard A.; Hansen, Harry J.** The influence of filled river channels on the hydrology of shallow aquifers on the Delmarva Peninsula [abs.]: Mining Eng., v. 18, no. 8, p. 40, 1966.

7092 **Garland, G. D.** (editor). Continental drift: Royal Soc. Canada Spec. Pub. 9, 140 p., illus., 1966.

The first part of this symposium, held at the annual meeting of the Royal Society of Canada in 1964, gives the views of three geophysicists, a botanist, and an astronomer. In these papers, separately cited, the present evidence for or against continental drift is reviewed, the authors drawing their own conclusions, not unanimously in favor of drift. The second part consists of papers, also separately cited, which throw light on the complicated structure of the Arctic and eastern seaboard of Canada, which must be taken into account in any attempt to reconstruct North America as part of Europe.—G.D.C.

Gerrard, Thomas A. *See* Peirce, H. Wesley, 6915

7147 **Gibbs, J. A.; Perkins, H. F.** Properties and genesis of the Hayesville and Cecil series of Georgia: Soil Sci. Soc. America Proc., v. 30, no. 2, p. 256–260, illus., tables, 1966.

Characterization of Cecil and Hayesville soils derived from acid crystalline rock in the Piedmont and Southern Blue Ridge Soil Provinces, respectively, indicate a great similarity except for fine sand content and clay mineralogy. Data obtained does not justify separation into two soil series.—Authors' abstract

6757 **Gilboa (Greenberg), Y.** On the hydrogeology of the Azua Valley (the Dominican Republic): Jour. Hydrology, v. 4, no. 2, p. 105–120, illus., tables, 1966.

The Valley of Azua, one of the driest regions of the Dominican Republic, is the southernmost part of a graben in which Pleistocene–Recent sediments cover plunging and downfaulted Tertiary structures. This fill is the exploited aquifer, fed by many streams flowing from the north which disappear when they reach the plain. Water of the aquifer is fresh, but in some areas is in danger of salinization due to sea-water intrusion or contamination by connate saline water in buried structures or salt in sediments and shallow water table zones. Ground-water maps and a table showing well sample analyses are included. This is the first hydrogeologic study in the Dominican Republic.—E.S.L.

7146 **Gile, L. H.; Hawley, J. W.** Periodic sedimentation and soil formation on an alluvial-fan piedmont in southern New Mexico: Soil Sci. Soc. America Proc., v. 30, no. 2, p. 261–268, illus., tables, 1966.

Gullies cut in alluvial-fan piedmont deposits at the southern end of the Jornada del Muerto basin show a succession of four major sediments, each having a distinct soil. Toward the basin axis the sediments thin and there is mergence of the land-surface soil with the oldest. The land-surface soils overlie much older rocks and in places are so thin that the buried soils must be considered in their classification. Gradual mergence zones of sediments, and filling of old channels by younger sediments can cause major soil changes not suggested by the smooth relief and uniform slope which crosses the soil boundaries.—E.S.L.

6695 **Gillett, L. B.** Geology of the Lake Assinica area, Abitibi Territory [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 550, 17 p., table, geol. map, 1966.

All bedrock in the area is Precambrian. The pre-Broadback Group of metasedimentary rocks lies in an easterly trending syncline across the middle of the area. Most of the metagabbro and metadiorite bodies are probably related to this Group, although some occur in the Broadback Group. Granites and granitic pegmatite have invaded the gneisses extensively. Tourmaline- and spodumene-bearing pegmatites are closely associated with a large body of porphyritic syenite intruded into the volcanic-sedimentary zone.—E.S.L.

Ginsburg, R. N. *See* Martin, Ernest L. 6719

Giroux, Mary J. *See* vanSteenburgh, W. E. 7070

Goddard, John G. *See* Bodine, Marc W., Jr. 6690

Godson, R. H. *See* Watkins, Joel S. 7052

Godson, Richard H. *See* deBremaecker, J. C. 6914

Goodell, H. G. *See* Stipp, J. J. 6986

Gordon, D. W. *See* Carder, Dean S. 6953

Graf, Donald L. *See* Anderson, Raymond J. 6825

Graham, A. R. *See* Kilburn, L. C. 6636

7118 **Granger, H. C.** Ferroselite in a roll-type uranium deposit, Powder River basin, Wyoming, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C133–C137, illus., table, 1966.

Delicate, stellate penetration twins of ferroselite occur in sandstone on the concave side of a roll-type uranium ore body in the Powder River basin, Wyo. Comparison with occurrences in the Ambrosia Lake uranium district, New Mexico, suggests that the margins of altered rock may contain selenium concentrations irrespective of the presence of uranium.—Author's abstract

7105 **Grantz, Arthur; Jones, D. L.; Lanphere, M. A.** Stratigraphy, paleontology, and isotopic ages of upper Mesozoic rocks in the southwestern Wrangell Mountains, Alaska, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C39–C47, illus., tables, 1966.

Reconnaissance field observations, fossils, and potassium-argon ages have provided new information on the upper Mesozoic strata of the Wrangell Mountains. The Kotsina Conglomerate is probably Middle or lower Upper Jurassic. Sandstone along the Chetaslina River may be Callovian (Jurassic), and nearby unfossiliferous shale and sandstone is probably also upper Mesozoic. A unit of sandstone, siltstone, conglomerate, and calcarenite, previously thought to be gradational downward into the Kotsina Conglomerate, yielded Hauterivian and Barremian (Lower Cretaceous)

fossils. Similar rocks occur in the northern Chugach Mountains and at Kuskulana Pass, where they rest on granodiorite dated as 141±5 m.y. Sandstone and siltstone with Albian (Lower Cretaceous) fossils rest on the Hauterivian to Barremian rocks at Kuskulana Pass, and shale and arkose of similar age rest on granodiorite dated as 126±4 m.y. near Mount Drum.—Authors' abstract

6968 **Greeley, Ronald.** Lectotypes of some lunulitiform bryozoan species: Jour. Paleontology, v. 40, no. 4, p. 969–970, 1966.

Lectotypes for eleven species described by Canu and Bassler in 1920 are selected from syntypic series.—R.C.D.

Greenberg, S. S. *See* Milici, R. C. 6639

7207 **Gregg, D. O.** An analysis of ground-water fluctuations caused by ocean tides in Glynn County, Georgia: Ground Water, v. 4, no. 3, p. 24–32, illus., table, 1966.

The tidal efficiencies of wells tapping the principal artesian aquifer decrease with distance from the influencing tidal body and also decrease with well depth. Although the magnitude of water-level fluctuation of these wells is largely dependent upon the distance to a large tidal body, the time of a high or a low water level in the wells is mainly dependent upon the time of a high or a low tide in a small, nearby tidal body. A modified formula for computing tidal efficiency is developed: TE = (barometric change—water-level change)/(barometric change-tidal change). From this formula, tidal efficiency can be calculated rapidly and easily.—*from* Author's abstract

Grey, Donald C. *See* Damon, Paul E. 6715

Grey, Donald C. *See* Haynes, C. Vance, Jr. 6985

6755 **Griffin, James B.** Radiocarbon dating and the cultural sequence in the Eastern United States, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 117–130, illus., tables [1966?].

The discussion is divided into four parts: postulated dates for fluted point sites and Early Archaic, radiocarbon dates for prehistoric copper, Hopewellian and Middle Woodland dates, and Late Woodland dates for the Upper Mississippi Valley and Great Lakes area. Tables and charts of these dates are included.—E.S.L.

Griffin, James B. *See* Crane, H. R. 7013

6804 **Groff, S. L.** (compiler). Proceedings of the 1st Montana coal resources symposium, 1964: Montana Bur. Mines and Geology Spec. Pub. 36, 89 p., illus., tables, 1966.

The proceedings of the Coal Symposium, held on Oct. 9–10, 1964, include 13 papers covering the history of coal mining, and coal resources and economics. Reprints of the coal section and a bibliography from "Mineral potential of eastern Montana—A basis for future growth", are given as appendixes. A map and table showing potential strip-mining areas accompany the proceedings.—E.S.L.

6699 **Gross, Eugene B.; Heinrich, E. William.** Petrology and mineralogy of the Mount Rosa area, El Paso and Teller Counties, Colorado—[Pt.] 2, Pegmatites: Am. Mineralogist, v. 51, nos. 3–4, p. 299–323, illus., tables, 1966.

Two contrasting swarms of pegmatite dikes occur intermingled in the Pikes Peak granite and related alkalic granites. The older dikes, calc-alkalic Pikes Peak type, occur as segregations and injected bodies only within Pikes Peak granite. The younger dikes, the alkalic Mount Rosa type, intrude both the Pikes Peak and its derivative fayalite granites along northeast-trending fractures. Each of the two types has distinctive minor element composition and distinctive major and accessory mineralogy. Zircons from Mount Rosa-type pegmatites give inconsistent lead-alpha ages.—B.C.H.

7211 **Groten, Erwin.** On linear regression prediction of mean gravity anomalies, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 53–57, illus., tables, 1966.

The prediction of mean gravity anomalies for areas of 1-by-1, 5-by-5, and 10-by-10 deg^2 from mean anomalies of the neighboring areas is discussed. The use of regression of gravity with other geophysical information for prediction is outlined.—Author's abstract

7213 **Groten, Erwin.** Accuracy aspects of gravity prediction from gravimetric and astrogeodetic data, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 71–73, illus., 1966.

The prediction of gravity anomalies in unsurveyed gaps from gravity and astrogeodetic observations is discussed. This method seems to be useful for smaller gaps within well-surveyed areas of the Earth's surface.—Author's abstract

6642 **Grubbs, David M.** Porosity index: Southeastern Geology, v. 7, no. 3, p. 131–134, illus., 1966.

A laboratory method for rapid determination of effective porosity of granular rock employing a Russell-type volumeter is described. Both the procedure and the equipment required are non-complicated, and values attainable compare favorably with data derived from more complicated methods.—Author's abstract

Grubich, Donald N. *See* Farnham, R. S. 6945

6987 **Gude, Arthur J., 3d; Sheppard, Richard A.** Silica-rich chabazite from the Barstow Formation, San Bernardino County, southern California: Am. Mineralogist, v. 51, nos. 5–6, p. 909–915, tables, 1966.

Authigenic chabazite from the Barstow Formation is high in silica and sodium and low in calcium, aluminum, and water. Indexed X-ray diffraction data for herschelite, chabazite, and silica-rich chabazite are given.—M.L.L.

6860 **Gulbrandsen, R. A.** Chemical composition of phosphorites of the Phosphoria Formation: Geochim. et Cosmochim. Acta, v. 30, no. 8, p. 769–778, illus., tables, 1966.

Results are presented of chemical analyses of 60 phosphorite samples from the Phosphoria Formation. The phosphate is basically apatite, with small but significant variable substitutions (Na, Sr, U, and Th for Ca; CO_3 and SO_4 for PO_4). Rare metals not associated with apatite are associated mainly with the organic-matter component; Cr is most abundant. The average phosphorite consists of about 80 percent apatite, 10 percent quartz, 5 percent muscovite-illite, 2 percent organic matter, 1 percent dolomite-calcite, 1 percent iron oxide, and 1 percent other components. Texturally it is a medium-grained pellet phosphorite.—D.B.V.

7035 **Gulbrandsen, R. A.; Kramer, J. R.; Beatty, L. B.; Mays, R. E.** Carbonate-bearing apatite from Faraday Township, Ontario, Canada: Am. Mineralogist, v. 51, nos. 5–6, p. 819–824, illus., tables, 1966.

A new analysis of apatite from Faraday Township, Ontario, shows a paired substitution of CO_3+F for PO_4 and of Na+rare earths for calcium in minute quantities. Infrared analysis indicates that the environment of the CO_3 ion in carbonate-apatite is different from that in calcite.—M.L.L.

6951 **Gupta, Indra N.** Use of reciprocity theorem for obtaining Rayleigh wave radiation patterns: Seismol. Soc. America Bull., v. 56, no. 4, p. 925–936, illus., 1966.

The reciprocity theorem is used to obtain Rayleigh wave radiation patterns from sources on the surface of or within an elastic semi-infinite medium. Nine elementary line sources are first considered. The results are then extended to the three

dimensional case of similar point sources in a homogeneous half space. Haskell's results for the radiation patterns of Rayleigh waves from a fault of arbitrary dip and direction of motion are reproduced in a much simpler manner. Numerical results on the effect of the depth of these sources on Rayleigh wave amplitudes are shown for a solid having Poisson's ratio of 0.25.—D.B.V.

6952 **Gupta, Indra N.** Response of a vertical strain seismometer to body waves: Seismol. Soc. America Bull., v. 56, no. 4, p. 785–791, illus., 1966.

Expressions have been derived for vertical strain due to P and SV type waves arriving at an arbitrary angle of incidence within a semi-infinite medium. The amplitude and phase relationships between vertical strain and vertical displacement have been investigated for both wave types, assuming a Poisson's ratio of 0.25. The effect of finite depth and finite length of the vertical strain instrument has been examined and found to be significant especially for small angles of incidence.—Author's abstract

7097 **Gupta, Ravindra N.** Reflection of plane elastic waves from transition layers with arbitrary variation of velocity and density: Seismol. Soc. America Bull., v. 56, no. 3, p. 633–642, illus., table, 1966.

The problem of reflection of plane elastic waves is generalized numerically to an arbitrary variation, with depth, of the elastic parameters inside a transition layer between two homogeneous half-spaces. Numerical results are given for some cases of interest.—Author's abstract

7005 **Güven, Necip; Kerr, Paul F.** Weathering effects on the structures of mica-type clay minerals: Am. Mineralogist, v. 51, nos. 5–6, p. 858–874, illus., tables, 1966.

Mica-type clay minerals have been subjected to intensive weathering in the basin of the Willard Reservoir, north of Ogden near the margin of Great Salt Lake. Weathering attacks the interlayer portion of the structure of layer silicates most intensively where the bonds are weakest. The pronounced continuous scattering accompanying the (02,11) diffraction band on the Guinier photographs and the absence of (*hkl*) reflections show that the layer silicates in the Willard clays possess an intensive disorder in their stacking sequence. The mica-type layers before weathering were similar to tetrasilicic members of dioctahedral micas.—*from* Authors' abstract

Haas, J. L., Jr. *See* Wyllie, P. J. 6846

7173 **Hackett, James E.** Geologic aspects of a water resources planning study in the Chicago metropolitan region [abs.]: Mining Eng., v. 18, no. 8, p. 40, 1966.

6878 **Halbouty, Michael T.** Geological and engineering concepts and economic significance of salt domes in the Gulf Coast region: New York Acad. Sci. Trans., ser. 2, v. 28, no. 3, p. 378–386, 1966.

This presentation briefly reviews the known information on salt structures and suggests that much is yet to be learned about these unique geologic features which have proved to be one of the most economically significant structural elements in the world.—D.B.V.

6800 **Halstead, E. C.** Aldergrove test hole, Fraser Valley, B. C.: Canada Geol. Survey Paper 64–51, 17 p., illus., tables, 1966.

A test hole was drilled at Aldergrove to a depth of 852 feet to determine the depth and nature of the unconsolidated deposits and the hydrologic properties of the principal aquifers. The stratigraphic section is complex, indicating repeated glaciations as well as eustatic changes of sea-level of greater magnitude than formerly realized. Prospecting for ground water is probably best within the upper 400 feet of material filling Fraser Valley.—Author's abstract

Hamilton, J. C. *See* Hawley, C. C. 7119

Hannon, W. J. *See* Wu, Francis T. 7095

7133 **Hansen, Arnold J., Jr.** Availability of ground water in the Dublin quadrangle, Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-170, scale 1:24,000, section, text, 1966.

Abundant ground water is available for domestic and industrial use in the Dublin quadrangle, the principal aquifer being Eocene sand. Limited data suggest that the Eocene strata dip southwestward about 25 feet per mile and are from 700 to 850 feet thick. Properly constructed wells in the deper sand may yield more than 700 gpm. Quality of water in the main zone of saturation is satisfactory for most uses; that of perched ground water depends upon local factors.—M.C.M.

Hansen, Harry J. *See* Gardner, Richard A. 7127

6684 **Hansen, Richard Otto.** Isotopic distribution of uranium and thorium in soils weathered from granite and alluvium [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7257, 1966.

Hanshaw, Bruce B. *See* Rubin, Meyer. 6716

Hanson, Larry G. *See* McManus, Dean A. 6966

6867 **Hantush, Mahdi S.** Wells in homogeneous anisotropic aquifers: Water Resources Research, v. 2, no. 2, p. 273–279, illus., 1966.

The effect of anisotropy on the flow of ground water has been of concern to many hydrologists. Nearly all solutions of flow problems now available do not take into consideration such effects, but the process of obtaining them may be used for problems in homogeneous and anisotropic aquifers. Boundary-value problems describing flow in homogenous anisotropic mediums may be changed by using a simple transformation of coordinates to problems whose solutions are either available or can be obtained through the usual processes of mathematical analysis Solutions are presented herein for the drawdown around wells in homogeneous anisotropic aquifers which, during the period of pumping and the subsequent period of recovery, may be assumed to be infinite in areal extent.—G.D.C.

7170 **Hardie, Byron S.** Nevada gold prospecting [abs.]: Mining Eng., v. 18, no. 8, p. 33, 1966.

6681 **Hardie, L. A.; Eugster, H. P.** The gypsum–anhydrite equilibrium at 1 atmosphere pressure [abs.], *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 166, 1966.

6806 **Harlton, Bruce H.** Relation of buried Tishomingo uplift to Ardmore basin and Ouachita Mountains, southeastern Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1365–1374, illus., 1966.

The Tishomingo horst and the deep seated normal faults of the Arbuckle Mountains fault system that bounds it extend approximately 30 mi beneath overlapping Cretaceous rocks into Bryan and Atoka Counties, Okla. The Sulphur fault, which bounds this horst on the northeast, truncates the Ti Valley fault of the Ouachita fault system indicating that major deformation of the Arbuckle system took place after that of the Ouachita. The Ardmore basin is parallel on the southwest to the Tishomingo horst and is an area of intense deformation.—E.K.M.

Harp, G. D. *See* Schell, William R. 6910

7106 **Harris, Leonard D.** Algal stromatolites of the Upper Cambrian Copper Ridge Dolomite in Union and Claiborne Counties, Tennessee, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C48–C53, illus., 1966.

Approximately 60 percent of the Upper Cambrian Copper Ridge Dolomite, which has an average thickness of 925 feet, is composed of algal stromatolitic structures. Two forms, each apparently indicative of a particular phase of intertidal

environment, are readily discernible. The most abundant stromatolite occurs as discrete, vertically stacked hemispheroids in widespread lateral zones from 5 to 140 feet thick. These zones are composed of finely to medium crystalline dolomite with abundant vugs. The other form, composed of a series of laterally linked hemispheroids, is best developed in silt-sized to very finely crystalline dolomite. Persistence of porous stromatolite zones into the subsurface, inferred from study of drill cuttings, offers a potential site for the accumulation of hydrocarbons.—Author's abstract

6814 **Harrison, C. G. A.** The paleomagnetism of deep sea sediments: Jour. Geophys. Research, v. 71, no. 12, p. 3033–3043, illus., table, 1966.

Paleomagnetic measurements made on deep sea sediments are described. The main features to be seen in the pattern of NRM directions in the sediment cores are: (1) Very few of the cores show reversals of NRM direction, but the position of the latest reversal in those which have a reversal correlate well in time. (2) There is evidence for a wobble of the Earth's main dipole field with a period between 10^5 and 10^6 years. The NRM in these sediments is thought to be stable.—Author's abstract

7081 **Harshman, E. N.** Genetic implications of some elements associated with uranium deposits, Shirley basin, Wyoming, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C167–C173, illus., 1966.

A systematic distribution of uranium, selenium, ferrous and ferric iron, carbon, beryllium, and sulfate sulfur is shown by analytical data on samples of unaltered sandstone, ore, and altered sandstone from a roll-type uranium deposit in the lower Eocene Wind River Formation of the Shirley basin. Transportation of uranium and other elements in a neutral to slightly alkaline, oxidizing solution and deposition by changes in the Eh and pH of that solution are suggested by the geochemistry of these elements at low temperatures and pressures.—Author's abstract

Hartner, F. E. *See* Walker, F. E. 7210

6916 **Harvey, J. R.; Foster, M. R.; Wermund, E. G.** Preferred alignments of salt domes in southern Louisiana, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 85–94, illus., 1966.

A statistical test is described for recognizing preferred alignments in a given set of points and applied to a map of salt domes. A polygon enclosing a set of points is divided into strips; the number of points in each strip are counted as a function at the orientation of the strips. This data is used to construct the test statistic. Both artificial and natural arrays, such as coastal salt domes, were tested. Salt domes in southern Louisiana have preferred alignments of N. 80° W., N. 80° E., and N. 5° W., related respectively to: the coast line, deltaic fronts and gravity faults; Lake Borgne Fault and Hancock Ridge parallel to extended Appalachian tectonic elements; and the major drainage. The test is applicable to other natural data, e. g., volcanoes and epicenters of earthquakes.—*from* Authors' abstract

Haskell, E. E., Jr. *See* Bianchi, W. C. 6883

Hassall, Geraldine I. *See* Callow, W. J. 7014

6685 **Hatcher, Robert Dean, Jr.** Structure of the northern portion of the Dumplin Valley fault zone in East Tennessee [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7257–7258, 1966.

Hawkes, I. *See* Roberts, Albert. 6963

Hawkins, Charles S. *See* Thompson, Lloyd G. D. 7223

Hawkins, James W., Jr. *See* Ragan, Donal M. 6828

7049 **Hawksley, Oscar.** Pleistocene bear fossils from a "bear bed" in Perkins Cave, Missouri [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 96, 1966.

7119 **Hawley, C. C.; Huffman, Claude, Jr.; Hamilton, J. C.; Rader, L. F., Jr.** Geologic and geochemical features of the Redskin Granite and associated rocks, Lake George beryllium area, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C138-C147, illus., tables, 1966.

Precambrian igneous rocks northwest of Lake George, Colo., consist of (1) catazonal Boulder Creek(?) Granodiorite, (2) mesozonal Silver Plume(?) Granite, and (3) epizonal rocks that include gabbro and monzonite, the Pikes Peak Granite, and the Redskin Granite, which is a late intrusive of the Pikes Peak Granite magma series. The Pikes Peak Granite of the area is an alkali granite that contains more than normal amounts of F, Sn, Li, Rb, and Be—a suite of trace elements generally found in greisen ore deposits. The somewhat younger Redskin Granite, which is herein named, has associated beryllium-bearing greisen. It is also an alkali granite that is enriched in F and contains more Sn, Li, Rb, and Be than the Pikes Peak Granite.—Authors' abstract

Hawley, J. W. *See* Gile, L. H. 7146

6762 **Hay, Richard L.** Zeolites and zeolitic reactions in sedimentary rocks: Geol. Soc. America Spec. Paper 85, 130 p., illus., tables, 1966.

Zeolites, among the most common authigenic silicate minerals, replace tuff of saline, alkaline lakes and form a substantial part of nontuffaceous pelitic rocks; are alteration products of volcanic glass in marine and fresh-water deposits; and the largest volumes occur in thick tuffaceous sedimentary rocks. The thickest and most wide-spread deposits known are Mesozoic analcimolites of probable saline-lacustrine origin. Several examples of zeolites in sedimentary rocks of various ages are described briefly to illustrate the different modes of occurrence and document aspects of zeolite origin. Their mineralogy may be correlated with composition of host rock, water chemistry of depositional and postdepositional environments, age, and burial depth. They may be precipitated chemically and may form by reaction of volcanic glass and aluminosilicate minerals in aqueous solutions. Many reactions involve metasomatism.—G.D.C.

7031 **Haye, Edward F.** Vertical density contrast key to finding reef with gravity: Oil and Gas Jour., v. 64, no. 38, p. 222-225, 1966.

Vertically extending density increases, caused by differential compaction over underlying buried topography, often produce shallow, low-relief gravity anomalies. These anomalies occur over deeper structure such as reefs. The anomalies can be detected by specially designed gravity surveys at a cost less than for seismic surveys.—S.E.F.

6655 **Hayes, Miles Oren.** Sedimentation on a semiarid, wave-dominated coast (south Texas) with emphasis on hurricane effects [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7258, 1966.

6739 **Haynes, C. Vance, Jr.** Carbon-14 dates and early man in the New World, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 145-164, illus., table [1966?].

Today, chiefly because of radiocarbon dating, it is known that the final cool-moist period during which early man flourished corresponds to the Valders stade and the subsequent recessional period, 8,000 to 11,500 years ago. Earlier evidence is inconclusive. Two sites in the Southwest with artifacts in stratified sequences and radiocarbon control provide useful information on cultural change but such sites are rare. Early man C-14 dates are listed by sites, and a sequence of maps showing the distribution of C-14 dated sites in North America with respect to sea level and ice borders is given.—E.S.L.

6985 **Haynes, C. Vance, Jr.; Damon, Paul E.; Grey, Donald C.** Arizona radiocarbon dates VI: Radiocarbon, v. 8, p. 1-21, illus., 1966.

Radiocarbon dates compiled between November 1, 1963, and November 15, 1965, are given for geochemical samples from California, Sudan, and Arizona; geologic-

paleoclimatic samples from Nevada, Utah, California, and Chile; early man–alluvial stratigraphy samples from Arizona, New Mexico, and Wyoming; and archeologic samples from Mexico, Wyoming, Hungary, Easter Island, Arizona, New Mexico, and Virginia.—M.C.M.

7171 **Hazen, Scott W.** Area of influence of an assay obtained in mine sampling [abs.]: Mining Eng., v. 18, no. 8, p. 33, 1966.

6830 **Hazleton–Nuclear Science Corp.** Vela Uniform, Project Shoal, Fallon, Nevada, October 26, 1963—Post-shot hydrologic safety, Final Rept.: U.S. Atomic Energy Comm. Rept. VUF–1014, 50 p., illus., tables, 1965 [1966].

The Shoal Event, a 12.5 KT nuclear detonation, occurred in the granite intrusive of the Sand Springs Range. Jointed, faulted, and fault-bounded metamorphosed Paleozoic and Mesozoic marine sediments comprise the rest of the range. Alluvial-filled valleys on either side act as aquifers. Until the rubble chimney fills with water and the aquifer reaches equilibrium, water containing radionuclides will not move far. It is concluded that the slow ground-water flow and radioactive decay preclude the possibility of hazardous concentrations migrating beyond the immediate area. Sampling should be continued.—E.S.L.

Healy, J. H. *See* Warren, David H. 6703

7065 **Heard, Hugh C.; Rubey, William W.** Tectonic implications of gypsum dehydration: Geol. Soc. America Bull., v. 77, no. 7, p. 741–760, illus., 1966.

A tenfold decrease in strength from 2.7 to 0.25 kb, was observed when the temperature of gypsum was increased from 10 to 150°C. This decrease is believed to result from the dehydration of gypsum with consequent rise in fluid pressure to a value approaching the confining (overburden) pressure. This mechanism of increasing the fluid pressure above the ambient may enable overthrusting to occur by the Hubbert–Rubey overthrust hypothesis; gypsum and/or anhydrite have been commonly observed at the sole of many thrusts. The same dehydration mechanism as postulated for gypsum may help to explain the common occurrence of ultramafic rocks along tectonic boundaries and the type of deformation that is widespread in pelitic and carbonate-bearing schists.—J.P.A.

6656 **Heath, Christopher Peter Macclesfield.** Microfacies of the Lower Bird Spring Group (Pennsylvanian–Permian), Arrow Canyon Range, Clark County, Nevada [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7258–7259, 1966.

Hebeda, E. H. *See* Priem, H. N. A. 7204

7200 **Hedberg, Hollis D.** Sugli aspetti geologici dell'origine del petrolio: Scula Azione 1966, no. 5, p. 91–119, 1966.

This review considers points in favor of organic genesis of petroleum; its nature and occurrence in different types of rock; distribution in relation to age, depth and temperature, and tectonism; optimum sedimentary conditions for deposition and migration; significance of microbic and catalytic actions, radioactivity, associations with certain elements, solidification, transport by water, effects of pressure and temperature, and variations in age. Examples of fields of different geologic ages are listed, genetic significance of variations in quality of oil and gas is given, and suggestions are outlined for development of research. Petroleum appears to be of organic origin, although traces may be inorganic, and a marine environment is most favorable at temperatures below 100°C, up to 300°C, with overlying pressure from rocks ≤3,000 feet thick; the age could be from Precambrian to Pleistocene.—G.D.C.

7045 **Heezen, Bruce C.; Schneider, E. D.; Pilkey, O. H.** Sediment transport by the Antarctic Bottom Current on the Bermuda Rise: Nature, v. 211, no. 5049, p. 611–612, illus., table, 1966.

It is shown that the Antarctic Bottom Current may be a principal factor in determining topography and sediment distribution of the Bermuda Rise. Its principal effects are in redistribution of the slowly accumulating pelagic lutites.

Controlled deposition during the final dissipation of the Antarctic Bottom Current may be responsible for the broad, thick, almost unstratified mantle of sediment which covers most of the Bermuda Rise.—D.B.V.

6964 **Heidecker, E.** The determination of in-situ stress and strain using photoelastic techniques—Discussion [of paper by A. Roberts and I. Hawkes, 1964]: Felsmechanik u. Ingenieurgeologie, v. 4, no. 1, p. 56–57, 1966.

Heidecker criticizes the use of photoelastic discs for stress measurements, and points out a simple experiment to demonstrate the importance of bond shrinkage which masks rock strain. Discs bonded to a variety of freshly cut rock specimens became strained after a few days; likewise additional discs applied to same surfaces several months later, but residual-strain relaxation must have ceased. In discs bonded to carefully polished rock surfaces, very low shear strains developed. In theory, delayed elastic strain is only a component of the strain at a point in underground rock. Thus disc measurements on hand specimens cannot indicate underground strain states; they are of even less value as indicators of underground stress states. Elastic anisotropy complicates the transfer from strain to stress. Roberts and Hawkes (1964) have disregarded these complications.—G.D.C.

Heinrich, E. William. *See* Gross, Eugene B. 6699

Heinrich, M. A. *See* Youngquist, Walter. 6969

7187 **Heinrichs, Walter E., Jr.** Geophysics in 1965 *in* The search for ore: Mining Eng., v. 18, no. 2, p. 77–78, 1966.

The greatest advancement was in the field of automatic data processing–compilation, interpretation, storage, and retrieval. Induced polarization (IP) continued to be the most used technique for geophysical exploration. Improved IP instrumentation and interpretation methods are predicted for 1966. Aerial methods (electromagnetic, pulse-transient) ranked second in use.—C.B.D.

7072 **Heiskanen, W. A.** (reporter). The extension of the gravity net to the unsurveyed areas of the Earth—Geophysical methods, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 75–77, 1966.

The geophysical method is helpful in prediction of gravity anomalies over long distance or for long areas. The principle of the geophysical extrapolation method is based on the fact that gravity anomalies are mostly caused by the topographic mass surplus of the continent and the bathymetric mass deficiencies of the oceans and by the isostatic compensating mass deficiencies and mass surplus. Because topographic and bathymetric masses are well known and the effect of isostatic compensating masses can be estimated, mean anomalies caused by topographic and compensating masses are easily obtained for unsurveyed areas. With high-speed computers the effects of topography and isostasy are easily computed if mean elevations of relatively small squares or blocks are known. Computations carried out at the Columbus Geodectic Center are reviewed.—V.S.N.

Helterbran, Wayne. *See* Jordan, James N. 6705

Hemley, J. J. *See* Reed, Bruce L. 7080

6666 **Henningsen, Dierk.** Die pazifische Küstenkordillere (Cordillera Costena) Costas Ricas und ihre Stellung innerhalb des süd-zentralamerikanischen Gebirges [with English summ.]: Geotektonische Forschungen, no. 23, p. 3–66, illus., tables, 1966.

In southern Costa Rica the Coastal Range parallels the central range, Cordillera de Talamanca, its middle Eocene to upper Miocene sediments traversed by dikes and sills of andesitic and basaltic rocks. On the northeastern slopes Pliocene gravels and agglomerates, covered with lateritic soils, rest unconformably on Miocene strata. These gravels also fill the Valle del General separating the two ranges. The Basal Complex, dated as Upper Cretaceous, is exposed on the Pacific side and consists of sediments mixed with extrusive and intrusive volcanics. The volcanic debris and

younger strata were derived from former Pacific islands. Late Miocene diastrophism tilted the strata, in some places mildly folding them; major faults control the shape of the Range. Uplift begun in the Pleistocene is still continuing.—G.D.C.

6712 **Herrin, Eugene; Taggart, James.** Epicenter determination for the Salmon event: Jour. Geophys. Research, v. 71, no. 14, p. 3503–3506, illus., 1966.

With data obtained from earthquakes and explosions before the Salmon event, it was possible to compute regional traveltime corrections and station corrections which reduced the location error for Salmon by a factor of 10 if times from all (91) stations were used and by a factor of 2 if times from only distant stations were used. When all stations were used, the error was less than 2 km, and the 0.90 confidence ellipse had an area of about 100 km^2. The computation when times from 23 distant stations ($\Delta > 20°$) were used gave an error of less than 6 km, a 0.90 confidence ellipse of about 900 km^2, and a 0.75 confidence ellipse of 500 km^2. The latter ellipse covered the true location.—Authors' abstract

6977 **Herz, Nathaniel.** Gold, *in* Treatise on analytical chemistry—Pt. 2, Analytical chemistry of inorganic and organic compounds, V. 4, Sec. A: New York, Interscience Publishers, p. 71–105, 1966.

In this chapter on the analytical chemistry of gold, a brief review is given of its early history, occurrence, recovery, and properties. Methods of sampling, separation, and determination of gold are described, the determination by fire assay in more detail than others.—G.D.C.

7121 **Heyl, A. V.; Delevaux, M. H.; Zartman, R. E.; Brock, M. R.** Isotopic study of galenas from the upper Mississippi Valley, the Illinois–Kentucky, and some Appalachian Valley mineral districts: Econ. Geology, v. 61, no. 5, p. 933–961, illus., tables, 1966.

Of the anomalous (J-type) leads analyzed, those from the Upper Mississippi Valley are most radiogenic, and show greatest variation; a lead from southeast Missouri is intermediate, and leads from the Illinois–Kentucky district are least radiogenic. Four galenas closely associated with igneous intrusions are also J-type. The radiogenic component shows a progressive increase toward the northeast in the Upper Mississippi Valley district, and toward the southeast in the Illinois–Kentucky district; whether this implies variable ratios from a single source or mixing of leads from multiple sources is unresolved. Samples from the Appalachian Valley districts and galena, presumably diagenetic, from shale and clay, have ordinary lead. W.S.W.

Heylmun, E. B. *See* Pratt, A. R. 6760

Heylmun, Edgar B. *See* Mayhew, E. J. 6919

6667 **Hilgenberg, Ott Christoph.** Bestätigung der Kennedy–Channel–Scherung durch die Bruchstruktur von Grönland und Nordost–Kanada [with English summ.]: Geotektonische Forschungen, no. 22, 74 p., 74 p., illus., 1966.

In opposition to the view that the hypothesis of continental drift depends on knowledge of sea-floor structure at 4,000 m depth, it is shown that tectonic structure at the surface of continental blocks suffices. On both sides of Kennedy Channel a rhombic pattern, predetermined by pressure along the equatorial bulge of the Earth, due to diminishing rotation speed, is projected repeatedly from granitic basement through all sedimentary layers. Examples show correlation between typical feature patterns and alinements on large-scale geological and geophysical maps. Reorientation of Kennedy Channel shear shows the area between Mackenzie River and eastern Greenland to be crossed by four sets of parallel lineaments. Recent paleomagnetic measurements support the assumption that continents represent the entire crust of 750,000,000 yr ago, when the Earth's diameter was half that of today.—G.D.C.

6648 **Hodges, Arthur L., Jr.** Ground water favorability map of the Batten Kill, Walloomsac River and Hoosic River basins: Montpelier, Vt., Vermont Dept. Water Resources, scale about 1 in. to 2 mi, 1966.

Listed well and test boring data indicate a thick deposit of water-bearing sand and gravel between North Dorset and South Bennington along parts of Batten Kill, Warm Brook, Paran Creek, Walloomsac River, and South Stream. The Hoosic River valley in the Pownal area contains sufficient thicknesses of water-bearing gravel to produce large quantities of water. Nine wells producing water from gravel average 186 gpm; ten wells tapping bedrock and till aquifers average 32 gpm. Further studies are recommended for a more detailed appraisal of ground-water availability.—M.C.M.

6941 **Hoekstra, Pieter.** Moisture movement in soils under temperature gradients with the cold-slide temperature below freezing: Water Resources Research, v. 2, no. 2, p. 241–250, illus., tables, 1966.

Moisture movement to a freezing front in unsaturated porous Fairbanks [Alaska] silt, measured by γ-ray attenuation, showed that the presence of an ice phase greatly enhances the amount of moisture transfer under temperature gradients. The chemical potential of unfrozen absorbed water in frozen soils, if in equilibrium with ice, is independent of total water content (unfrozen water plus ice), so water content in the frozen soil changes constantly. Moisture flow takes place under temperature gradients through the films of unfrozen water. Since the thickness of these films decreases with temperature, the rate of water transport also decreases rapidly below O°C.—*from* Author's abstract

7002 **Hoffer, Jerry M.** Compositional variations of plagioclase feldspar from a basaltic lava flow: Am. Mineralogist, v. 51, nos. 5–6, p. 807–813, illus., table, 1966.

A detailed study of the Rock Creek basalt flow reveals significant relationships between chemical composition of the plagioclase feldspar and texture. The An content of the groundmass plagioclase varies inversely with size and directly with the amount of associated glass. The rate of cooling, after extrusion, determined the composition of the groundmass plagioclase. The plagioclase phenocrysts, averaging 20 percent more calcic than the corresponding groundmass plagioclase, are intratelluric.—Author's abstract

6775 **Holmquest, Harold J.** Stratigraphic analysis of source-bed occurrences and reservoir oil gravities: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1478–1486, illus., 1966.

Source-bed reservoir relations are inferred from statistic and lithologic study of oil fields of southeastern U.S. and Permian basin. Source-bed lithologies have distinct petroleum characteristics; oil gravity and gas-condensate conversion points are related to depth of burial. Gray and green shale may produce oil of higher gravity for equal depth than black or brown shale, implying that open-marine waters produce higher gravity oil than stagnant marine waters. Analysis of world examples confirms structural updip yet stratigraphic downward migration of oil from its source if principal source is above oil pool. Overburden of about 2,000 feet is needed for flush migration from source to sizable pool; earliest accumulations are essentially gas. Isopachous maps of intervals 2,000–3,000 feet above source bed will reveal structures present during migration.—S.P.S.

6920 **Holser, William T.** Bromide geochemistry of salt rocks, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 248–275, illus., tables, 1966.

Theoretical profiles of bromide content against salt thickness are derived experimentally; for a constant inflow-evaporation-reflux regime, profiles are monotonic logarithmic functions. A Recent salt pan in Baja California has bromide between 75 ppm and 38 ppm; the value to be expected in basal salt is indeterminate and may be a function of crystallization conditions. Most basal salts of earlier geological ages fall in this range and show no trend with geological time that would imply a change in the Cl/Br of the oceans. Most evaporite basins have suffered

multiple incursions of sea water with recycling of earlier salts and loss of bitterns; meteoric water may be important in recycling. The theory of profiles permits explicit calculation of brine depth from the basal halite/initial slope ratio, independent of the evaporation–flow regime, but initial brine depths are somewhat less than final salt thickness.—G.D.C.

Hope, Roger A. *See* Crowell, John C. 6647

Hopkins, D. M. *See* Wolfe, Jack A. 6911

7178 **Houston, Wesley M.; Snow, Robert E.** The economic evaluation of land pebble phosphate deposits [abs.]: Mining Eng., v. 18, no. 8, p. 43, 1966.

6790 **Howard, J. H.** Vertical normal stress in the Earth and the weight of the overburden: Geol. Soc. America Bull., v. 77, no. 6, p. 657–659, illus., table, 1966.

The vertical normal component of stress in the Earth at a point of some depth Z is, in general, equal to the weight of the overburden per unit area plus contributions from the vertical shear components of stress. Observations of structural geology imply that the possibility of contributions from these shears should not be overlooked. This note also emphasizes that measurements of the vertical normal component which are not equal to the weight of the overburden per unit area are not necessarily valid.—Author's abstract

7168 **Howard, Thomas E.; Padan, John W.** Problems in evaluating marine mineral resources: Mining Eng., v. 18, no. 6, p. 57–61, illus., table, 1966.

The problems, which are considerable and formidable, include location and sampling of mineral deposits, development of tools and techniques on site, mineral processing and waste disposal, and high operating costs. Problems in drilling for tin at Cape Creek, Alaska, are presented as an example.—C.B.D.

6843 **Howe, Jane.** Bibliography and index of Oklahoma geology, 1965: Oklahoma Geology Notes, v. 26, no. 3, p. 55–73, 1966.

Hower, John. *See* Czamanske, Gerald K. 6859

6989 **Hower, John; Mowatt, Thomas C.** The mineralogy of illites and mixed-layer illite/montmorillonites: Am. Mineralogist, v. 51, nos. 5–6, p. 825–854, illus., tables, 1966.

Twenty-one samples of illite and mixed-layer illite/montmorillonite have been separated and analyzed after removal of organic material and free iron oxide. All (including illites) examined are of the 1Md polymorph, are close to ideally dioctahedral, and have excess H_2O+. The C.E.C. is proportional to the percent expandable layers. All have low tetrahedral charges. The relationship between K_+ and percent mica layers terminates at a potassium content significantly less than that of a true mica. The excellent relationship between structure and composition in the group leads to the conclusion that the non-expandable layers are of lower charge than true micas and contain lenses of trapped water.—*from* Authors' abstract

7166 **Hoy, Robert B.** Memorial to Arthur Coe Spencer (1871–1964): Geol. Soc. America Bull., v. 77, no. 7, p. P139–P144, 1966.

7148 **Hsu, Pa Ho.** Formation of gibbsite from aging hydroxy-aluminum solutions: Soil Sci. Soc. America Proc., v. 30, no. 2, p. 173–176, illus., tables, 1966.

Hydroxy-aluminum solutions of $NaOH/AlCl_3 = 0.3$ to 2.7 were prepared and aged for two years. Those solutions from 1.8 to 2.7 were meta-stable and the hydroxy-aluminum polymers further hydrolyzed and polymerized; eventually gibbsite formed in association with a decrease in H. The solution concentration of chloride was found to be the major factor determining the rate of hydrolysis and consequently, the formation of gibbsite.—Author's abstract

Huffman, Claude, Jr. *See* Hawley, C. C. 7119

Huffman, Claude, Jr. *See* Swanson, Vernon E. 7196

Hulston, J. R. *See* Kaplan, I. R. 6847

Humphrys, C. R. *See* Veatch, J. O. 6877

7180 **Hurd, Donald W.; Shaw, William W.** The carnallite problem in the Saskatchewan potash field—Some empirical relations as determined by seismic isopachs [abs.]: Mining Eng., v. 18, no. 8, p. 44, 1966.

6842 **Hurley, P. M.** (editor). Advances in Earth science—Contributions to the International Conference on the Earth Sciences, Massachusetts Institute of Technology, 1964: Cambridge, Mass., M.I.T. Press, 502 p., illus., tables, 1966.

The first six chapters of this book deal with the Sun, solar-planetary relations, and large-scale motions of the atmosphere, followed by three chapters on the dynamics of oceans. Seven chapters on the solid Earth consider mantle convection, mechanical properties of the deep Earth in response to disturbance of gravitational equilibrium resulting from change in speed of rotation; recent advances in seismology present new information on changes at shallow depth. Finally the constitution of the Earth's interior is reexamined in the light of new research on high-pressure phases and more extensive heat-flow data, including a chapter on isotopic geochronology. A number of these papers are cited separately —G.D.C.

7221 **Innes, M. J. B.** The state of gravity mapping in Canada, November 1964, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 26–27, illus., 1966.

A regional gravity mapping program with stations at 8- to 10-mile intervals has been under way in Canada since 1958; about 8,000 stations are being added each year. Maps released to date in the Gravity Map Series, initiated in 1961, and older maps included in Publications of the Dominion Observatory are listed; miscellaneous older maps also available are given.—V.S.N.

6649 **Irvine, T. N.; Smith, C. H.** Primary oxide minerals in the layered series of the Muskox intrusion [abs.]: Econ. Geology, v. 61, no. 4, p. 794–795, 1966.

6779 **Isaacs, Kalman N.** Recognition of structures from airborne magnetics: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1502–1506, illus., 1966.

The requirements for drawing qualitative data from a total-intensity airborne magnetometer map include a general appreciation of the form which the induced anomaly will take under different conditions of strike, dip, and magnetic inclination, together with geologic insight and imagination. Essentially, rock units can be delineated by differences or similarities in the extent, slope, orientation, relief, anomalous frequency, and general intensity levels of the magnetically anomalous zones and the individual anomalies making up those zones. Examples of air magnetic surveys are analyzed.—S.P.S.

6765 **Jackson, Everett D.** Chemical variation in coexisting chromite and olivine in chromitite zones of the Stillwater Complex [abs.]: Econ. Geology, v. 61, no. 4, p. 794, 1966.

Jackson, Wayne H. *See* Warren, David H. 6703

Jacoby, C. H. *See* Peyfuss, Kurt F. 6749

6744 **Jacoby, Charles H.** Effect of geology on the hydraulic fracturing of salt, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 311–320, illus., 1966.

In New York State initial interpretation of structures based on the plastic flow and leaching of salt by ground water have given way, in light of additional geological information, to a theory of a system of thrust and normal faults. Former isopach and structural maps depicting folds and failing to explain hydraulic fracturing results have been discarded for the Watkins Glen area. Areas such as Wayne County, Mich., underlain by flat dipping beds with gentle monoclinic folds can be shown by isopach maps. In some cases, these beds have incorporated secondary masses of crystalline salt, due to leaching by ground water. In some locations, lithologic and/or chemical changes in the salt's composition cause erratic results in hydraulic fracturing. Fractures along the axis of folds form conduits for solutions to travel.—G.D.C.

6973 **Janke, N. C.** Effect of shape upon the settling velocity of regular convex geometric particles: Jour. Sed. Petrology, v. 36, no. 2, p. 370–376, illus., 1966.

A measure of sedimentary particle shape, H, is synthesized from the following particle parameters: Reynolds number, a friction component, a form factor, an angularity factor, longest dimension, intermediate axis, short axis, nominal diameter, surface area, and an average of angles concave to the C axis. Theoretical studies of the effectiveness of H in a Stokes regime and in a turbulent regime suggest that H is useful as a measure of the effect of shape upon settling velocity. Corrections required for effects of particle asymmetry and alternate possible settling orientations are not included in calculations for H.—R.A.C.

7149 **Jenkins, Evan C.** Geologic map of the Milo quadrangle, Kentucky–West Virginia, and the part of the Webb quadrangle in Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–543, scale 1:24,000, section, text, 1966.

Natural gas, coal, and sand are developed mineral resources in the Milo and Webb quadrangles; of potential value are clay, claystone, sandstone, and brine. The majority of gas wells produce from multiple zones, but most production is from Ohio Shale, with larger initial volumes from Greenbrier Limestone. Eight of the 20 coal beds are 28 inches or more thick; none of the beds has been fully exploited. Sand dredged from Rockcastle Creek has an average output of 60 tons per day.—M.C.M.

Jessen, F. W. *See* Nowotny, Ben. 6748

6786 **Jewett, John Mark.** Memorial to Walter H. Schoewe (1891–1966): Geol. Soc. America Bull., v. 77, no. 6, p. P113–P116, portrait, 1966.

6721 **Johnson, Frederick.** The impact of radiocarbon dating upon archaeology, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF–650652, p. 762–784 [1966?].

The impact of the C–14 method of counting time on North American archeology is described, and the history of the foundation and emergence of radiocarbon chronology is traced. The question of the antiquity of man in America arose early and as the cultural complexes were correlated with deposits related to glacial phenomena, disagreement among geologists became a problem. The real break came with the introduction of C–14 dating. Dating of a number of sites at 7,000 B.C. to 14,000 B.C. lead to the emergence of a culture known as the Intermontane Western Tradition, distributed from Yukon to South America. Emergence of later chronologies is described, and C–14 dates close the gap between these and the earlier Paleo–Indian complexes. The problem of the mound–builders is not entirely solved, and C–14 dating is not successful in the Arctic areas.—E.S.L.

6869 **Johnson, J. G.** Middle Devonian brachiopods from the Roberts Mountains, central Nevada: Palaeontology, v. 9, pt. 1, p. 152–181, illus., 1966.

Middle Devonian stratigraphy in the Roberts Mountains is briefly reviewed and limestone strata below the Devils Gate Limestone are assigned to a brachiopod–rich formation, the Denay Limestone (new name). Walcott's *Skenidium devonicum* is made type species of a new dalmanellid genus *Vallomyonia* and his *Cryptonella? circula* is assigned to *Leptathyris*. Fifteen species of brachiopods of the *Leptathyris*

circula zone (new name) and the *Pentamerella* subzone in the lower part of the Denay Limestone are described; Eifelian assignment is suggested. Three new species and one new subspecies are *Pentamerella wintereri, Hadrorhynchia eurekaensis, Echinocoelia denayensis, and Warrenella kirki praekirki.* Cyrtinacea is proposed as a superfamily.—*from* Author's abstract

7201 **Johnson, J. W.** Estimating the importance of nearshore sediment movement in engineering problems, *in* Modern trends in hydraulic engineering research—Central Water and Power Research Sta., Golden Jubilee Symposia, 1966, V. 2: Poona, India, Central Water and Power Research Sta., p. 43–50, illus., 1966.

In many coastal engineering problems a knowledge of the nature and character of nearshore sediment movement is of utmost importance to success of the project. Past experience with sediment deposition and transportation at similar engineering works is perhaps the most reliable for information on expected conditions, but in the absence of such information recourse must be made to other methods such as natural features of the shoreline, heavy mineral analysis, and tracer studies. The refractive effect should be taken into account while establishing prevailing direction of littoral drift. Tracer methods are expensive, and may be inconclusive. Examples are given from California coastal areas.—G.D.C.

7048 **Johnston, G. H.; Broan, R. J. E.** Occurrence of permafrost at an Arctic lake: Nature, v. 211, no. 5052, p. 952–953, illus., 1966.

The distribution of permafrost was determined in a small lake about 5 mi northeast of Iniwik, Northwest Territories, selected because it was completely isolated from other water bodies which might influence the ground thermal regime. The effect of this small water body on the occurrence of permafrost is very pronounced. A deep thawed zone below the lake is a direct result (permafrost is probably completely absent below it), and the thermal effect of the lake extends for some distance beyond its perimeter.—D.B.V.

6669 **Jones, Blair F.** Geochemical evolution of closed basin water in the western Great Basin, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 181–200, illus., tables, 1966.

The composition of saline waters in inland basins results largely from weathering processes with simple evaporation and selective precipitation; silicate hydrolysis reactions are schematically combined with CO_2 uptake. Order and rate of precipitation under variable conditions relate to type of underlying rock. All processes are well illustrated in intermontane areas of the western Great Basin, where major drainage areas may be classified according to major anion in the most saline waters; each anion points to distinctive lithology and weathering processes. Predominant chloride indicates sedimentary rocks of marine origin and solution processes; carbonate, igneous lithologies and hydrolysis of primary silicates; and sulfate, ore mineralization and acid alteration. Secondary hydrologic, organic, and mineral precipitation can severely alter but not obliterate initial control of water composition.—G.D.C.

Jones, Blair F. *See* Anderson, Raymond J. 6825

Jones, Clark. *See* Milici, R. C. 6639

Jones, D. L. *See* Grantz, Arthur. 7105

7165 **Jones, Walter B.** Memorial to Edward Franklin Richards (1903–1965): Geol. Soc. America Bull., v. 77, no. 7, p. P137–P138, portrait, 1966.

Jordan, J. N. *See* Carder, Dean S. 6953

6705 **Jordan, James N.; Mickey, Wendell V.; Helterbran, Wayne; Clark, Don M.** Travel times and amplitudes from the Salmon explosion: Jour. Geophys. Research, v. 71, no. 14, p. 3469–3482, illus., tables, 1966.

Data are presented from 143 seismic stations recording signals from the Salmon nuclear event. Traveltimes at smaller distances generally confirm the high upper mantle velocities indicated by Gnome for the eastern United States. Traveltimes for the area east of the Rocky Mountains may generally be represented by the equation $t = \Delta/8.3 + 8$ sec (Δ in km).. At $\Delta = 10°–20°$ multiple arrivals are apparent, and beginning near 16° late initial arrivals are observed which correspond to Jeffreys–Bullen traveltime. Amplitudes were generally higher than expected for regional and for teleseismic distances, but lower in the 13°–22° range, in western United States. Magnitude determination procedures need revision.—D.B.V.

Kahle, James E. *See* Crowell, John C. 6647

7130 **Kalliokoski, J.** Diagenetic pyritization in three sedimentary rocks: Econ. Geology, v. 61, no. 5, p. 872–885, illus., 1966.

The Leicester marcasite bed (Devonian), N.Y., the Clinton ironstone (Silurian), N.Y., and Wabana pyrite beds (Ordovician), Newfoundland, show varying degrees of early diagenetic, pseudomorphous pyritization and marcasitization of fossils and hematite–chamosite oolites. The fossils are replaced by either a mixture of framboidal and microgranular sulfides, or by microgranular or fibrous sulfides alone, but the oolites are replaced by structureless pyrite and fibrous marcasite, never by framboidal pyrite. The pyritized material occurs with other pyrite and lesser quantities of marcasite in concentric and radial concretions, crystal aggregates, framboids, framboidal clusters, and other spherical structures, all considered to be of early diagenetic age.—*from* Author's abstract

Kanasewich, E. R. *See* Russell, R. D. 7077

6954 **Kane, Julius.** Teleseismic response of a uniform dipping crust (Part 1 of a series on crustal equalization of seismic arrays): Seismol. Soc. America Bull., v. 56, no. 4, p. 841–859, illus., 1966.

If crustal structure is anything but a plane–parallel configuration, the signals received by the individual elements of a seismic array will include distortion effects characteristic of the local geometry, and consequently to achieve optimal signal processing the records of arrays located on realistic configurations will have to be equalized to some standard reference. A ray procedure is introduced here for calculating theoretical seismograms for the teleseismic response of an array of stations located above a uniform dipping crust (wedge–shaped). In terms of this mathematical model, the signal distortion effects of the geometry are demonstrated, and equalization techniques permitting superior signal recovery are discussed.—D.B.V.

6847 **Kaplan, I. R.; Hulston, J. R.** The isotopic abundance and content of sulfur in meteorites: Geochim. et Cosmochim. Acta, v. 30, no. 5, p. 479–496, illus., tables, 1966.

The sulfur isotopic abundance and content were studied in 20 iron and stony meteorites. Troilite is the chief sulfur component in iron meteorites, and the δS–34 ranges from 0 to +0.6 permil with respect to Canyon Diablo troilite. The δS–34 content of isolated sulfur compounds of stony meteorites varies from +2.5 to −5.5 permil with respect to Canyon Diablo; the weighted average for all compounds of each meteorite, however, falls within ±1 permil of Canyon Diablo. The S–33 distribution closely follows S–34. Apparently differentiations have occurred in a closed system (meteorites or parent body), starting from a single source of sulfur. There is no evidence of biological activity.—D.B.V.

Kaufman, A. *See* Thurber, David L. 6909

6743 **Kaufman, H.** Remark on the exponential velocity–depth function: Royal Astron. Soc. Geophys. Jour., v. 10, no. 5, p. 551, 1966.

In connection with Bullen's paper (1965) on the exponential velocity–depth function, attention is drawn to previous work by Slotnick (1936), Mott–Smith (1939), and Kaufman (1953) relating to this function.—D.B.V.

7212 **Kaula, W. M.** Global harmonic and statistical analysis of gravimetry, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 58–67, illus., tables, 1966.

The most general possible linear auto-analysis of gravimetry obtains a result that agrees with the best independent test within 30° for the location of the eight principal extremums of the worldwide geoid. However, this geoid still gives an impression of falling short of exploiting the available data. Part of the difficulty is computational, but substantive improvement seems practical in three directions: (1) linear cross analysis, (2) use of a reference model derived from satellite orbits, and (3) nonlinear auto-analysis.—*from* Author's abstract

Keefer, W. R. *See* Case, J. E. 7116

6897 **Keen, Charlotte; Loncarevic, B. D.** Crustal structure on the eastern seaboard of Canada—Studies on the continental margin: Canadian Jour. Earth Sci., v. 3, no. 1, p. 65–76, illus., tables, 1966.

Results of several seismic refraction profiles on the continental shelf and slope of the eastern seaboard of Canada are now available. Gravity measurements which begin near the coast of Nova Scotia and end over the abyssal plain have also been made along two tracks perpendicular to the shelf edge. Various models for the crustal and upper mantle structure are presented. A density distribution assumed for each model resulted in a computed gravity field satisfying the observed gravity measurements. The models in agreement with all seismic data suggest that horizontal and vertical density variations occur in the upper mantle down to 100 km. The results indicate a mantle density of 3.42 g/cm^3 under the continental shelf and 3.32 g/cm^3 under the ocean basin.—Authors' abstract

Keen, M. J. *See* Berger, Jon. 7041

Keester, Kenneth L. *See* White, William B. 6999

6691 **Keller, W. D.** Geochemical weathering of rocks—Source of raw materials for good living: Jour. Geol. Education, v. 14, no. 1, p. 17–22, illus., 1966.

The chemical weathering of rocks and minerals is one of the most vitally important topics in the science of geochemistry; it is the basis on which life is sustained. The soil by which food is nourished is composed dominantly of products of rock weathering. Likewise many raw materials for building and industry owe their origin to geochemical processes. Examples of processes briefly described include oxidation and hydration of iron-containing minerals, chemical weathering of pyrite, argillic weathering involving kaolin and montmorillonite groups, and plant nutrition as a phase of chemical weathering.—G.D.C.

7154 **Kenney, T. C.** Residual strength of fine-grained minerals and mineral mixtures: Norges Geotek. Inst. Pub. 68, p. 53–58, illus., tables, 1966.

In drained direct-shear tests on very thin samples of fine-grained minerals, mineral mixtures, and natural soils, it was found that for pure minerals the angle of residual shear strength could vary from 3° to 35°, the larger-lattice minerals providing the lowest values and the massive minerals the highest. For mixtures of two pure minerals, the residual strength depended on the constituent minerals and their relative volume; that of natural soils was dependent on the constituent minerals. It is concluded that residual shear strength of minerals and natural soils is controlled largely by mineralogy. No unique relationships were found between residual strength and grain size or plasticity. Soils from U.S.A., Canada, and Norway were tested.—G.D.C.

Kerr, Paul F. *See* Güven, Necip. 7005

7107 **Ketner, Keith B.** Comparison of Ordovician eugeosynclinal and miogeosynclinal quartzites of the Cordilleran geosyncline, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C54–C60, illus., tables, 1966.

Ordovician quartzite of the Cordilleran miogeosyncline is extremely pure, medium-grained quartz arenite whose grains are frosted, well rounded, and well sorted. Approximately correlative quartzites of the eugeosyncline are equally pure, and the grains are similarly frosted and equally well rounded, but they are more coarse and not quite so well sorted. The high degree of compositional and textural maturity of quartzites of both parts of the geosyncline indicates that they were derived from sedimentary terranes. Stratigraphic and textural relations show that quartzites of the eugeosyncline were derived from the west side of the geosyncline.—Author's abstract

6946 **Kigoshi, Kunihiko; Kobayashi, Hiromi.** Gakushuin natural radiocarbon measurements V: Radiocarbon, v. 8, p. 54–73, illus., table, 1966.

Radiocarbon dates are listed from tree ring samples from Japan; geologic samples from Japan, Australia, Pacific islands, and Antarctica; and archeologic samples from Missouri, Kansas, Japan, Australia, and Pacific islands. Datings were carried out from September 1964 to October 1965.—M.C.M.

6636 **Kilburn, L. C.; Wilson, H. D. B.; Graham, A. R.** Nickel sulfide ores related to ultrabasic intrusions in Canada [abs.]: Econ. Geology, v. 61, no. 4, p. 803, 1966.

Kim, S. M. *See* Noakes, John E. 6753

6890 **King, Elbert A., Jr.** Major element composition of Georgia tektites: Nature, v. 210, no. 5038, p. 828–829, illus., tables, 1966.

A new chemical analysis of a Georgia tektite is presented and compared with previous major element data. The Georgia tektites are very similar in major element composition to silica-rich bediasites. They show decreasing aluminum, ferrous iron, and possibly titanium contents with increasing silica. In view of the identical K-Ar ages, close chemical similarity, and general geographic association, the North American tektites are probably the product of a single event; the Georgia tektites and the Martha's Vineyard specimen can be classed as a distinct subgroup characterized by low soda-potash ratios.—D.B.V.

6787 **King, Elizabeth R.; Zietz, Isidore; Alldredge, Leroy R.** Magnetic data on the structure of the central Arctic region: Geol. Soc. America Bull., v. 77, no. 6, p. 619–646, illus., 1966.

On the North American side of the underwater Lomonosov Ridge, a zone of closely spaced, high-amplitude magnetic anomalies, similar to typical profiles over the Precambrian rocks of the Canadian shield, includes nearly half of the Canadian Basin and probably all of the Central Arctic Basin. On the other side of the Ridge in the Eurasian Basin, the magnetic profiles resemble typical oceanic magnetic profiles and are relatively smooth or show only minor anomalies, making it doubtful that the Mid-Atlantic Ridge extends through this part of the Arctic. The Arctic region consists of an oceanic area on the Eurasian side and a downdropped continental Precambrian complex on the North American side. Magnetic maps and profiles are included.—A.G.

7186 **King, J. W.; Austin, S. R.** Some characteristics of roll-type uranium deposits at Gas Hills, Wyoming: Mining Eng., v. 18, no. 5, p. 73–80, illus., 1966.

Analyses of samples from 2 traverses across and on either side of a uranium roll indicate a definite pattern. The bleached-white barren ground has total iron and organic carbon content, altered feldspars, single euhedral pyrite crystals, moderate to extreme depletion of S^{-34}, some Se, low U, SO_4, $CaCO_3$, loss on ignition (LOI), and no brown limonitic specks. The solution front contains brownish uranium ore, sparse brown limonitic specks, and some depletion of S^{-34}. The brownish gray protore section has pronounced clusters of pyrite crystals, moderate iron, SO_4, LOI, sparse brown limonitic specks, and no Se.—C.B.D.

6961 **Kirchmayer, Martin; Dennis, J. G.** Information from joint diagrams: Felsmechanik u. Ingenieurgeologie, v. 4, no. 1, p. 36–40, illus., 1966.

An example of fracture distribution from the north-west German coal field brings out differences in informative value between the histogram, the rose diagram, the stereographic projection, the Müller unit square, and either of the two last-named combined with additional symmetry data. The histogram and the rose diagram yield only limited information, the contoured stereogram combined with additional symmetry data is most informative. While the stereographic projection is the scientifically most useful for dealing with angular and three-dimensional relations, it may be replaced by the unit square where this is more expedient for geological engineers.—G.D.C.

Kistler, Robert B. *See* Barnard, Ralph M. 6852

7076 **Kivioja, Lassi A.; Lewis, Albert D. M.** Free-air gravity anomalies caused by the gravitational attraction of topographic, bathymetric features, and their isostatic compensating masses and corresponding geoid undulations, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 89–95, illus., 1966.

Mean elevations and depths of all even 5°-by-5° surface elements and their corresponding isostatic compensating masses in the Airy-Heiskanen, T = 30 km, isostatic system together with the published gravity information were used to compute mean free-air anomalies for all 2592 5°-by-5° surface elements covering the entire surface of the Earth. By using these free-air anomalies, geoid undulations were computed by the Stokes formula at every 5°-by-5° surface element, and the corresponding global map is given. Similar computations by the Stokes formula was performed by using all published 5°-by-5° free-air anomalies based on actual gravity measurements and on the international gravity formula wherever available and by filling in all empty areas by the computed anomalies. The corresponding global geoidal map is given.—Authors' abstract

7137 **Klemic, Harry.** Geologic map of the Oak Grove quadrangle, Kentucky-Tennessee: U.S. Geol. Survey Geol. Quad. Map GQ-565, scale 1:24,000, section, text, 1966.

The cavernous nature of near-surface limestone in the Oak Grove quadrangle caused problems in foundation and drainage system construction at the Fort Campbell Military Reservation. Excavations encountered caverns which had to be blasted open and filled to provide adequate support for construction: for the drainage system, knobs and pinnacles of solid limestone extending up into the thick overburden were encountered. Test drilling to determine depth to bedrock was required.—M.C.M.

Knauer, G. A. *See* Stipp, J. J. 6986

Kobayashi, Hiromi. *See* Kigoshi, Kunihiko. 6946

Kodama, H. *See* Brydon, J. E. 7006

7034 **Kohls, D. W.; Rodda, J. L.** Gaspeite, (Ni, Mg, Fe) (CO_3), a new carbonate from the Gaspé Peninsula, Quebec: Am. Mineralogist, v. 51, nos. 5–6, p. 677–684, tables, 1966.

The name gaspeite applies to the nickel carbonate end member, the natural material being magnesian gaspeite with magnesium and some iron carbonate in solid solution. It occurs as a vein in siliceous dolomite with small amounts of niccolite, annabergite and gersdorffite in the wall rock. The crystals are light green and up to 0.5 mm with good rhombohedral cleavage. X-ray data, infrared spectrum, and chemical analysis are discussed.—E.H.R.

6981 **Kolthoff, I. M.; Elving, Philip J.; Sandell, Ernest B.** (editors). Treatise on analytical chemistry—Pt. 2, Analytical chemistry of inorganic and organic compounds, V. 4, Sec. A: New York, Interscience Publishers, 452 p., illus., tables, 1966.

This is one volume of a series which will present a concise, critical, comprehensive, and systematic treatment of all aspects of classical and modern analytical chemistry. Volume 4 deals with analysis of aluminum, calcium, gold, radon–radium, silver, and strontium–barium, in unlettered chapters by individual authors, separately cited in the Bibliography of North American Geology.—G.D.C.

6881 **Korver, John A.** Fluid flow from nuclear chimneys: Water Resources Research, v. 2, no. 2, p. 297–310, illus., 1966.

To assess the feasibility of using nuclear explosives to create large underground rubble chimneys into which liquid wastes can be ejected, a predictive capability has been developed by matching laboratory model studies with mathematical analogs. The effects of varying permeability, porosity, input flow rates, and chimney dimensions were examined; variations between laboratory and mathematical model results were less than 10 percent. This paper describes the laboratory model studies of two hydrologic environments, the development of the mathematical models, and the numerical solutions obtained with the latter. Also summarized are two examples of potential applications of nuclear explosives to the field of waste disposal; results indicate that for many selected hydrologic conditions it is feasible to use the rubble chimneys in permeable but unsaturated formations.—G.D.C.

7016 **Kowalski, Sandra J.; Schrodt, Ariel G.** Packard Instrument Company radiocarbon dates II: Radiocarbon, v. 8, p. 386–389, 1966.

Radiocarbon measurements made during 1965 are reported on geologic samples from Alaska, Bahamas, and Indiana and one archeologic sample from French Polynesia.—M.C.M.

7117 **Koyanagi, Robert Y.; Okamura, Arnold T.** Hawaiian seismic events during 1964, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C129–C132, illus., 1966.

During 1964, 30,285 earthquakes were detected by seismographs in Hawaii. Of these, 481 of magnitude 2.0 to 5.5 were located and plotted along the Hawaiian Ridge. One hundred and seven earthquakes were reported felt by residents of Hawaii, and three were felt as far as Maui and Oahu islands. The Kilauea summit region and the Kaoiki fault region, on the island of Hawaii, were the areas of the highest earthquake concentration.—Authors' abstract

Kramer, J. R. *See* Gulbrandsen, R. A. 7035

Krammes, J. S. *See* Debano, L. F. 7025

6872 **Kremp, G. O. W.; Ames, H. T.** (compilers). Catalog of fossil spores and pollen—V. 25, Mesozoic and Tertiary spores and pollen: University Park, Pa., Palynolog. Labs., Pennsylvania State Univ., 168 p., illus., 1966.

Systematic materials herein presented were derived from 14 papers published between 1956 and 1963; their selection has been guided by a desire to broaden, as well as intensify, coverage of particular stratigraphic units and geographical localities. A total of 146 specific and 14 generic protologs are republished, representing primarily late Mesozoic and Tertiary species reported from Asian, European, and American localities. Supplementary information and original illustrative materials have been added.—G.D.C.

6907 **Krueger, Harold W.** The preservation and dating of collagen in ancient bones, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 332–337, illus. [1966?].

Very few dates have been performed on bone from archeological sites although it is abundant and offers the unique potential of direct dating. Probably this is due to the fact that dating of bone is reputed to be difficult and tedious, and 75 percent of the samples dated by both organic and inorganic fractions show wide discrepancies. The separation technique used by Geochron Laboratory in carbon-14 dating more than 30 samples of bone during the past year is described. The

collagen dates are almost always reliable, but dates on the carbonate portion of those showing significant alteration will be too young. Collagen is recoverable from bones as old as 40,000 years, where they are not greatly oxidized.—E.S.L.

6991 **Krueger, Harold W.; Weeks, C. Francis.** Geochron Laboratories, Inc. radiocarbon measurements II: Radiocarbon, v. 8, p. 142–160, 1966.

Radiocarbon dates are presented on a small fraction of the total number of measurements made during 1964 and 1965 as well as data on some samples previously dated but not published. Geologic samples were from eastern United States, Minnesota, Alaska, Canada, Mexico, Costa Rica, and Austria; and archeologic samples from southeastern and western United States, Mexico, Guatemala, Peru, France, Africa, Japan, and Pacific islands.—M.C.M.

Kudo, A. *See* Bottinga, Y. 7036

6637 **Kullerud, G.; Yund, R. A.; Moh, G.** Phase relations in the Fe–Ni–S, Cu–Fe–S, and Cu–Ni–S systems [abs.]: Econ. Geology, v. 61, no. 4, p. 804, 1966.

Kullerud, G. *See* Craig, J. R. 6638

6729 **Kumai, Motoi.** Microspherules in snow and ice-fog crystals: Jour. Geophys. Research, v. 71, no. 14, p. 3397–3404, illus., table, 1966.

Spherules found in snow crystals, ice-fog crystals, fallout particles, and fly ash were studied with an electron microscope. Less than 0.7 percent of the 1,004 snow crystals examined (from Greenland, United States, and Japan) contained spherules of possible extraterrestrial origin. The study also showed that snow crystals are formed mainly on clay mineral particles by heterogeneous nucleation.—D.B.V.

Lagaay, R. A. *See* Priem, H. N. A. 7204

Lamb, Mary E. S. *See* Norvitch, Ralph F. 6827

Lambert, D. G. *See* Archambeau, C. B. 6711

7156 **Lambert, T. W.** Availability of ground water in the Heath quadrangle, Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–168, scale 1:24,000, section, text, 1966.

Large undeveloped supplies of ground water are available for domestic and industrial use in the Heath quadrangle. Aquifers are Eocene sand, and Pliocene(?) and Pleistocene gravel, with yields up to 500 gpm and 400 gpm, respectively. Quality of water from these Cretaceous and Tertiary sediments is excellent for most uses.—M.C.M.

7074 **Lambert, Walter D.** The isostatic reduction of gravity data and its indirect effect, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 81–84, tables, 1966.

The indirect effect, that is the correction for the difference between the real geoid and the cogeoid or isostatic geoid, is discussed. The work of Heiskanen and Niskanen (1941) in calculating this indirect effect and the revision necessary to bring data in line with modern ideas regarding the depth of compensation are reviewed. The mathematics of this effect can be complicated, and it is suggested that the International Association of Geodesy appoint a special committee to study the subject and make recommendations that all geodesists conform to certain standards in their publications; for example, the committee would determine whether the Pratt or Airy type of isostasy would be used, the type of compensation (equality of mass or hydrostatic equilibrium) to be used, and the like.—V.S.N.

Landisman, Mark. *See* Mueller, Stephen. 6741

6742 **Landisman, Mark; Mueller, Stephen.** Seismic studies of the Earth's crust in continents—[Pt.] 2, Analysis of wave propagation in continents and adjacent shelf areas: Royal Astron. Soc. Geophys. Jour., v. 10, no. 5, p. 539–548, illus., 1966.

A detailed analysis of wave propagation in continents and adjacent shelf areas is presented, which demonstrates how the sialic low-velocity zone postulated in the first part of this work (ibid., Mueller, p. 525–538) and related concepts can bring the results of seismic crustal refraction and reflection measurements into better agreement. The well known Haslach profile, from the Black Forest into the German foreland of the Alps, is reexamined as an example. The method used for the solution is described briefly, and refraction and reflection data are compared. Most of the features determined seem to have at least regional significance. Earthquake focal depths in several moderately stable regions are then related to the sialic low-velocity zone, and it is confirmed that the inclusion of this zone in crustal models can be used to explain the propagation of the $\bar{P}$ and Lg guided waves.—D.B.V.

Langenheim, R. L., Jr. *See* Cassity, P. E. 6967

6663 **Langer, Arthur M.** Mineralogy and physical properties of Mojave Desert playa crusts [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7352, 1966.

Langway, C. C., Jr. *See* Oeschger, Hans. 6754

Lanphere, M. A. *See* Grantz, Arthur. 7105

6693 **Lasalle, Pierre.** Geology of the Hébertville area (unconsolidated sediments), Lac Saint-Jean, Jonquière-Kenogami and Roberval counties [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 546, 12 p., table, geol. map, 1966.

The surficial sediments of this area, resting on Precambrian and Ordovician rocks, are all Pleistocene (Valders and younger), and Recent. Several forms of drift, and lake and sea sediments are described and the Pleistocene history is reviewed. Ground water and road materials possibilities are mentioned. Stream sediment samples were collected for geochemical study, and landslide possibilities assessed.—E.S.L.

6657 **Lasca, Norman Paul, Jr.** The surficial geology of Skeldal, Mesters Vig, Northeast Greenland [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7259, 1966.

Lee, C. R. *See* Cowan, J. C. 6763

7120 **Lee, Donald E.; Coleman, Robert G.; Bastron, Harry; Smith, Vertie C.** A two-amphibole glaucophane schist in the Franciscan Formation, Cazadero area, Sonoma County, California, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C148–C157, illus., tables, 1966.

A detailed study of a large glaucophane schist tectonic block has shown that the primary assemblage actinolite-glaucophane-garnet-epidote has been partly replaced by retrograde chlorite and pumpellyite. The whole rock and each of the major mineral phases have been analyzed for major and minor elements. Results of this study are consistent with the hypothesis that the primary metamorphic assemblage represents a high-grade schist that has been dislocated from its bedrock location by upward tectonic movement. The retrograde assemblage may have formed during the period of tectonic dislocation.—Authors' abstract

Lee, Fitzhugh T. *See* Nichols, Thomas C., Jr. 7104

7202 **Lee, Fitzhugh T.; Nichols, Thomas C., Jr.** Rupture phenomena in the Silver Plume Granite, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C29–C33, illus., 1966.

Fractures, slickensides, and gouge produced during laboratory compressive testing of cylinders of Silver Plume Granite resemble fractures noted in the granite during surface and subsurface mapping in the Straight Creek area, Colo. Formation of gouge and slickensides in the laboratory is believed to be due primarily to energy

release rather than to movement. Fault displacements in granitic terrane should be examined in the light of these findings.—Authors' abstract

6956 **Lehner, Francis E.; Press, Frank.** A mobile seismograph array: Seismol. Soc. America Bull., v. 56, no. 4, p. 889–897, illus., 1966.

A movable array composed of Ranger type seismometers, 60-day film recorder, and 7-day magnetic tape recorder housed in compact trailers is described, which is useful where frequent instrument relocation is desirable as in P-delay, microseismicity, aftershock, and signal-to-noise-ratio studies. Conveniences such as solid state amplifiers, radio and clock circuitry, internal calibration, and minimum installation time are special features. A week of unattended recording is possible with battery supply, and up to 60 days with commercial power. Useful magnification up to several million is available, depending on the frequency band selected.—D.B.V.

Lehr, James R. *See* Wedow, Helmuth. 7129

Lennox, D. H. *See* Bukhari, S. A. 6810

6879 **Lenz, A. C.; Churkin, Michael, Jr.** Upper Ordovician trilobites from northern Yukon: Palaeontology, v. 9, pt. 1, p. 39–47, illus., table, 1966.

The trilobites *Robergia yukonensis* sp. nov., *Cryptolithoides*, and *Ampyxina salmoni* Churkin are described from the Road River Formation. They occur above the Ashgillian (Late Upper Ordovician) graptolite zone of *Dicellograptus complanatus* var. *ornatus* and below beds containing the graptolite *Climacograptus scalaris* var. *normalis* of possible earliest Silurian age. *Robergia* and *Cryptolithoides*, although widely distributed geographically, have hitherto been reported from only Middle or presumed Middle Ordovician beds, and as a result have been considered reliable indices of that series.—Authors' abstract

Leong, K. W. *See* Erickson, R. L. 6896

Leopold, E. B. *See* Wolfe, Jack A. 6911

6702 **Leopold, Luna B.; Davis, Kenneth S.; LIFE editors.** Water: New York, Time Inc. (LIFE Science Library), 200 p., illus., tables, 1966.

This book tells of the nature of water, what it can do and how it is used by man. Each text chapter is supplemented by a picture essay, which may be read independently, offering a different perspective. Included in the topics considered in the eight chapters are: the abundance, chemistry and properties of water; the hydrogeologic cycle; the underground reservoir; the role of water in erosion of landscapes; and man's control and development of rivers and water resources. The chemical content of water in the United States is summarized in an appendix. G.D.C.

LePichon, Xavier. *See* Talwani, Manik. 6714

LeRun, J. *See* Coursaget, J. 6948

LeVan, D. C. *See* Toewe, E. Clayton. 6832

Lewis, Albert D. M. *See* Kivioja, Lassi A. 7076

7066 **Lewis, D. R.** Exoelectron-emission phenomena and geologic applications: Geol. Soc. America Bull., v. 77, no. 7, p. 761–769, illus., 1966.

The graph of the amount of exoelectron emission from a rock versus temperature is characteristic of the number and energies of defects in the surface and the bulk rock. The defect population may be related to the mechanical strength and the influence of the tectonic and thermal history of the rock. A device for producing these graphs is described.—A.G.

6658 **Lewis, John Hubbard.** Petrology and diagenesis of Upper Cambrian rocks in central and western Colorado [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7259–7260, 1966.

6768 **Lewis, Laurence A.** The relations of hydrology and geomorphology in a humid tropical stream basin—The Rio Grande de Manati, Puerto Rico [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7255, 1966.

6880 **Liakopoulos, Aristides C.** Theoretical prediction of evaporation losses from groundwater: Water Resources Research, v. 2, no. 2, p. 227–240, illus., 1966.

The transient values of water pressure, water content, and rate of water evaporation from soils can be predicted theoretically from the mathematical model representing the physical problem of the evaporation phenomena from soils. Evaporation of water from a soil surface is an initial-value problem arising in many cases of water transfer through soils. A nonsteady state leads to the mathematical model of a nonlinear parabolic partial differentiation equation. Because of the strong nonlinearity, the governing partial differentiation equation is approximated, and is integrated for initial and boundary conditions corresponding to the evaporation phenomena. The procedure for the numerous calculations is programmed with the aid of an electronic digital computer.—*from* Author's abstract

Libby, W. F. *See* Berger, Rainer. 6942

6736 **Libby, Willard F.** Radiocarbon and paleomagnetism, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 348–356 [1966?].

Possible disturbances in radiocarbon content that could cause significant error in dates, fall into two classes: disturbances of the rate of production by cosmic rays including cosmic-ray flux variations, variations in the solar magnetic shield, and in the Earth's magnetic field; and disturbances of the mixing reservoir of exchangeable carbon with which high-atmospheric radiocarbon is mixed including effects of cooling of the ocean surface and of decrease in the volume of sea water during the Ice Age. Of all disturbances, paleomagnetism is the one most likely to be important, therefore variation in strength of paleomagnetism can be studied by means of radiocarbon dates.—E.S.L.

Libby, Willard F. *See* Berger, Rainer. 6901

6902 **Libby, Willard F.** Natural radiocarbon and tritium in retrospect and prospect, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 745–751 [1966?].

Some of the problems that arose in early work with radiocarbon dating and tritium hydrology (the mixing problem for oceans and the atmosphere, and equilibrium within the biosphere) are described. Present day questions that are vital are isotopic fractionation and chemical exchange between the sap of trees and the wood in rings. In prospect, the significance of radiocarbon and tritium for archeology, geology, geophysics, and geochemistry, seems to be considerable. The deviation between radiocarbon and historical and tree-ring dates at about the fifth millennium is described.—E.S.L.

Lidz, Barbara. *See* Lidz, Louis. 6778

6778 **Lidz, Louis; Lidz, Barbara.** Foraminiferal biofacies of Veracruz reefs: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1514–1517, illus., 1966.

The reefs display foraminiferal biofacies indicating two distinct phenomena: (1) The two faunal assemblages present, an *Ammonia beccarii* group and an *Elphidium*-miliolid group, are commonly mixed together and denote vigorous wave and current action in the littoral zone surrounding the reefs; where silt content increases arenaceous Foraminifera constitute a sizable precentage of the fauna. (2) Fossil Foraminifera of different ages are present, probably due to reworking of ancient sediments near the reefs.—S.P.S.

LIFE editors. *See* Leopold, Luna B. 6702

6652 **Lindsley, D. H.** Iron-titanium oxide minerals—experiment and theory [abs.]: Econ. Geology, v. 61, no. 4, p. 798, 1966.

6721 **Linn, Kurt O.; Adams, Samuel S.** Barren halite zones in potash deposits, Carlsbad, New Mexico, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 59–68, illus., 1966.

Detailed mine mapping has provided information on character and origin of abundant barren zones, called "salt horses" in potash beds of the Carlsbad district. The ore zone contains three ore members, each about 2.5 feet thick, separated by orange halite marker beds. The salt horses are irregular in size and shape; their width ranges from 1 to 350 feet, their length from 15 to over 550 feet; in cross section they have domal form. Those limited to the bottom ore member are commonly associated with small anticlines. The beds in the salt horses are thinner than in the ore; the color of the clay changes from gray in ore to brown in the salt. Pods of other salt minerals occur in ore near the salt horses; disseminated polyhalite of the marker beds is locally concentrated. The best explanation for these features seems to be that NaCl-saturated brines entered the ore from below and formed salt horses by selective leaching of sylvite.—G.D.C.

Lipman, Peter W. *See* Christiansen, Robert L. 6960

6857 **Lloyd, R. M.** Oxygen isotope enrichment of sea water by evaporation: Geochim. et Cosmochim. Acta, v. 30, no. 8, p. 801–814, illus., tables, 1966.

An evaporation mechanism proposed by Sverdrup [1937] is used as a model to interpret the changes in isotopic composition that occur during the evaporation of sea water. The relative humidity at the site of evaporation is shown to be an important factor in determining the net isotopic enrichment, especially at very high salinities. From these results it is proposed as a working hypothesis that brines originating by evaporation of sea water in a humid coastal environment will attain δO-18 values no higher than 6 permille.—Author's abstract

6912 **Lokke, Donald H.; Brent, Millard D.** Ector Chalk Formation (Austin Group, Upper Cretaceous) in northeast Texas: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1510–1514, illus., 1966.

New subsurface data permit stratigraphic analysis of the Austin Group in northeast Texas. In the Dallas area this group is mainly chalk which grades eastward into two chalk tongues separated by a terrigenous clastic interval. The Ector Chalk Formation is the lower chalk unit; the Bonham Clay, Blossom Sandstone, and Brownstown Marl from the overlying clastic interval, and the Gober Chalk Formation is the upper chalk unit. The Ector Chalk Formation is considered to be lower Coniacian in central Texas. The Ector Chalk Formation is shown to be continuous across central and eastern Fannin County, Texas, which helps to define more precisely the geologic history of the Austin Group in northeast Texas.—S.P.S.

Lomnitz, Cinna. *See* Epstein, B. 7164

Loncarevic, B. D. *See* Keen, Charlotte. 6897

Long, Austin. *See* Damon, Paul E. 6715

6751 **Long, Austin.** Techniques of methane production for C^{14} dating, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 37–40, illus., tables [1966?].

The Smithsonian Radiocarbon Dating Laboratory uses a modified commercial methane system with two flow type ruthenium catalyst reactors. Tritium contamination may be introduced through the catalyst and the hydrogen, but can be avoided by proper selection of hydrogen and pretreatment of catalyst. Radon contamination in the methane results from certain types of samples, but can be removed on activated charcoal at -40°C. Isotopic fractionation in the various steps

has been checked, and could become significant if reaction yield is less than 90 percent.—Author's abstract

6944 **Long, Austin; Mielke, James E.** Smithsonian Institution radiocarbon measurements III: Radiocarbon, v. 8, p. 413–422, 1966.

Most of the analyses here listed were performed during 1965 and include archeologic samples from eastern and central United States, Costa Rica, Colombia, Venezuela, Brazil, and Iran; and geologic samples from Arizona, New Mexico, South Carolina, and Maryland.—M.C.M.

7198 **Loomis, Harold G.** Spectral analysis of tsunami records from stations in the Hawaiian Islands: Seismol. Soc. America Bull., v. 56, no. 3, p. 697–713, illus., 1966.

Power spectrums for three tsunami recorded at several Hawaiian stations and at Midway were obtained by digital methods. A given tsunami produced spectrums at nearby stations that were somewhat similar for low frequencies but even this similarity disappeared for stations far apart. Likewise, a given station gives its spectral imprint to tsunami incident upon it, but only qualitative similarities are found. The time changes in tsunami spectrums at a given station do not support any simple picture of a local response function. The energy decay curves show the arrival of reflected energy from (sometimes) identifiable sources. Time changes in mean frequency of incident energy are not immediately explainable.—D.B.V.

Loosli, H. *See* Oeschger, Hans. 6754

6766 **Low, M. J. D.; Coleman, I.** Measurement of the spectral emission of infrared radiation of minerals and rocks using multiple-scan interferometry: Appl. Optics, v. 5, no. 9, p. 1453–1455, illus., 1966.

Their spectral emission of a variety of minerals and rocks was measured at a specimen temperature of 20°C. A multiple-scan interference spectrometer was used. The samples were located within a cold-box during the measurements, the experimental arrangement thus simulating the conditions to be found in the field.—Authors' abstract

Lowdon, J. A. *See* Dyck, W. 6947

Luft, S. J. *See* Byers, F. M., Jr. 7150

Luth, W. C. *See* Scarfe, C. M. 6996

Luth, W. C. *See* Peters, Tj. 6997

6836 **MacDonald, Gordon J. F.** The figure and long-term mechanical properties of the Earth, *in* Advances in Earth science—Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 199–245, tables, 1966.

Ambiguity in empirical evidence for continental drift, and doubtful theoretical treatment of convection, lead to controversy over mechanical properties of the Earth's mantle and structure of its interior. No theory allows extrapolation of laboratory phenomena over geologic time scales; the surest guide is found in geophysical observations. Consistency of data for the Tertiary strongly supports methods of paleomagnetism; data for rocks older than Permian are limited. Many transcurrent faults with large displacements are known, but there is little agreement as to the importance of strike-slip motion over geologic time. In considering oceanic rises, mid-ocean ridges, and thickness of sea-floor sediments, the rate of erosion has varied widely. From satellite geodesy, implied large-scale temperature or chemical inhomogeneities within the Earth are given further significance in geodynamics.—G.D.C.

7044 **MacDonald, Gordon J. F.** Mantle properties and continental drift, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 18–27, 1966.

Geophysical studies pose objections of two kinds to continental drift. The first rests on effects of moving continental blocks on the mantle structure; the second depends on proposed mechanisms, all of which are ruled out except that of convection. Evidence bearing on large-scale structure of the upper mantle is reviewed. New evidence from satellite observations suggests far more complicated mechanical properties of the Earth than those envisioned by proponents of convection theory. Recent gravity, heat flow, and seismological observations suggest that differences in continental and oceanic structures extend to depths of several hundred kilometers, requiring a mechanism of drift which will maintain this deep structure. An elastoviscous model yields readily to theoretical reaction—solid for high-frequency excitations, viscous fluid for low-frequency deformation.—G.D.C.

6659 **MacNamara, Edlen E.** Soils of the Howard Pass area, northern Alaska [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7260, 1966.

6677 **Mamay, Sergius H.** *Tinsleya*, a new genus of seed-bearing callipterid plants from the Permian of north-central Texas: U.S. Geol. Survey Prof. Paper 523-E, p. E1-E15, illus., 1966.

A large collection of Permian plants was made in Baylor County, Tex., from the Lueders Limestone of the Wichita Group. The collection contains a small but interesting florule dominated by a seed-bearing plant of callipteroid aspect. Some of the fronds bear large seeds terminally or marginally on the pinnules. The plant is named *Tinsleya texana*, n. gen., n. sp. It is the first known occurrence of a callipterid with seeds attached, and it establishes the group as true pteridosperms. The fruiting habit of *Tinsleya* may lend support to the classical theory of evolution of the angiospermous carpel.—S.H.M.

7090 **Manheim, Frank T.** A hydraulic squeezer for obtaining interstitial water from consolidated and unconsolidated sediments, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C256-C261, illus., table, 1966.

A squeezer based on designs developed by P. A. Kriukov has been constructed, using fabricated and commercially available parts, and used with a standard laboratory press to recover interstitial water from sediments. Analyzable amounts of water were extracted from as little as 2 g of relatively compact sediment at pressures of 3,000 to 9,000 psi (approximately 200 to 600 kg/cm^2). Extraction of water from most samples of core materials from Recent to Paleocene sediments was completed in three minutes. The residue after squeezing is in the form of a compact pellet which may be further dried to determine total water content of the original sample. The present work confirms Soviet experience, with similar squeezers, that pressure does not appreciably affect the composition of extracted waters when proper precautions are observed.—Author's abstract

6845 **Mapes, Royal H.** Late Mississippian lycopod branch from Arkansas: Oklahoma Geology Notes, v. 26, no. 4, p. 117-120, illus., 1966.

A nearly complete branch of *Lepidophloios* sp. is described from the Fayetteville Formation, Fayetteville, Washington County, Ark., from which a number of nautiloid and goniatite cephalopods have been described. The specimen branches dichotomously at a mean angle of 76.5° at intervals of about 24.4 cm, and has 12 branch endings. A covering of collapsed pyritized "bark" surrounds an undistorted calcified stele. Diamond-shaped leaf cushions in high relief spiral upward around the branch from left to right. Leaf scars resemble those of *Lepidodendron volkmannianum* Steinberg, 1825, when the latter is oriented in reverse to its growth position. A branch described from the Fayetteville by C. D. White (1937) as *Lepidodendron* sp. 2 may be *Lepidophloios*.—V.M.J.

Marinenko, John. *See* May, Irving. 6975

6719 **Martin, Ernest L.; Ginsburg, R. N.** Radiocarbon ages of oolitic sands on Great Bahama Bank, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 705-719, illus., tables [1966?].

Carbon-14 measurements are given for both the external shells and nuclei from nine samples of oolitic sands collected from the surfaces of extensive spreads deposited by tidal currents. The nuclei were dated at about 2,000 to 3,000 years, whereas the external shells were not over 200 or 300 years old. The procedure used and possible sources of error are discussed as well as the process of oolith formation.—E.S.L.

7046 **Mason, Brian H.** Composition of the Earth: Nature, v. 211, no. 5049, p. 616–618, tables, 1966.

A composition for the mantle+crust, the core, and the Earth as a whole is derived on the assumptions that (1) the composition of mantle+crust is the same as the oxidic material of bronzite chondrites, and (2) troilite in bronzite chondrites is incorporated in the core, the rest of which is nickel-iron of the same composition as in bronzite chondrites. Results are tabulated. The estimate for the mantle+crust shows a remarkable degree of convergence with the mantle calculated by Green and Ringwood (1963) on a completely different basis, suggesting that information now available does suffice to reach a fair approximation of the chemical composition of the Earth's interior.—D.B.V.

7208 **Matlock, W. G.** Recharge distribution determined by analog model: Ground Water, v. 4, no. 3, p. 13–16, illus., table, 1966.

A two-dimensional passive element electric analog model was used to determine the spatial distribution of natural ground-water recharge in the Santa Cruz River basin of southern Arizona. Existing records were used to draw a ground-water level contour map of the area in its undeveloped condition. The model was made to duplicate these contours by varying inputs from known locations of recharge. Recharge distribution as determined by the model was consistent with previous estimates, but no direct correlation was found with the contributing drainage area.—Author's abstract

7153 **Matthews, Robert A.** Meteorites on display at the California Division of Mines and Geology mineral exhibit: California Div. Mines and Geology Mineral Inf. Service, v. 19, no. 7, p. 107, 110–111, illus., table, 1966.

Of the ten meteorites tabulated, only two are from California—the Ivanpah and a polished and etched slice of the Goose Lake meteorite. Several tektites and a replica of Canyon Diablo are included in the display. Five meteorites, besides Goose Lake, are represented by slices, and two of these are being studied.—E.S.L.

6975 **May, Irving; Marinenko, John.** A micropycnometer for the determination of the specific gravity of minerals: Am. Mineralogist, v. 51, nos. 5–6, p. 931–934, illus., 1966.

The pycnometer described can be filled with a high reproducibility. Novel features are the reproducible closure by means of a metal ball, and the delicate method of detecting the end of the evaporation of excess liquid.—E.H.R.

6919 **Mayhew, E. J.; Heylmun, Edgar B.** Complex salts and brines of the Paradox Basin, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 221–235, illus., tables, 1966.

Wells drilled for oil and gas in the Paradox Basin of Utah have encountered several zones of supersaturated and complex brines in rocks of Pennsylvanian, Mississipian, and Devonian age. Analyses of over 200 brine samples indicate commercial possibilities for the extraction of magnesium, potassium, bromine, boron, lithium, and other minerals from the brines, particularly in the Moab area. The most concentrated have been found in Pennsylvanian rocks, especially in clastic breaks between salt beds in the Paradox Formation. Beds are frequently brecciated because of salt flowage. Porous Mississippian dolomites and limestones may be as promising as overlying Pennsylvanian units, especially where faulted against the Paradox beds. Selected partial analyses, including one well drilled for brine, are presented herein.—G.D.C.

Mays, R. E. *See* Gulbrandsen, R. A. 7035

7125 **McCaleb, Stanley B.** Thermogravimetry as an aid to the X-ray study of the carbonate minerals [abs.]: Mining Eng., v. 18, no. 8, p. 33, 1966.

McCarthy, J. H., Jr. *See* Erickson, R. L. 6896

McClain, W. C. *See* Empson, F. M. 6696

McClurg, D. R. *See* Davis, S. N. 7055

7088 **McClymonds, N. E.; Ward, P. E.** Hydrologic characteristics of the alluvial fan near Salinas, Puerto Rico, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C231-C234, illus., 1966.

The alluvial fan of the Río Nigua (known locally as the Río Salinas) is an important source of ground-water supply in the vicinity of Salinas, P.R. Study of data from wells indicates that the thickness texture of the alluvial deposits, the specific capacity of wells, and the mineralization of the ground water are related to the configuration of the bedrock surface beneath the fan; the thickest and most permeable deposits are in valleys in the bedrock surface, and the thinnest and least permeable deposits are above the intervening ridges. Recognition of this relationship affords a basis for selecting the parts of the area with the greatest potential for the development of large ground-water supplies.—Authors' abstract

7163 **McConnell, Duncan.** Shallow-water phosphorites [discussion of paper by D. R. Pevear, 1966]: Econ. Geology, v. 61, no. 5, p. 967-968, 1966.

Contemporaneous or prior existence of calcium carbonate as a necessary condition for formation of phosphorites is an unwarranted assumption (Pevear, ibid., p. 251-266).—W.S.W.

McCoy, F. W., Jr. *See* Moberly, R., Jr. 6943

7061 **McEvilly, T. V.** Parkfield earthquakes of June 27-29, 1966, Monterey and San Luis Obispo Counties, California—Preliminary report, preliminary seismic data: Seismol. Soc. America Bull., v. 56, no. 4, p. 967-971, illus., 1966.

The sequence began with two foreshocks at 0100 and 0115 GMT on June 28, 1966, with M = 3 and 2, respectively. The two largest shocks occurred at 0409:56.5 (M = 5.3 BRK, 5.6 PAS) and 0426:13.8 (M = 5.5 BRK, 5.6 PAS) with a smaller event(M = 2.5±) at 0418. The third major shock occurred on June 29 at 1953:26.2 (M = 5.0 BRK, 4.8 PAS). The epicenters of the three largest shocks are 3-4 km apart at most. A heavy aftershock sequence followed the M = 5.5 earthquake. The two large shocks of June 28 have identical P-wave first-motion fault-plane solutions, with a vertical plane striking N. 33° W.; the motion appears to have an upward component on the west side, at about 20° from pure strike-slip motion.—D.B.V.

7094 **McEvilly, Thomas V.** The earthquake sequence of November 1964 near Corralitos, California: Seismol. Soc. America Bull., v. 56, no. 3, p. 755-773, illus., table, 1966.

A sequence of more than 100 aftershocks with magnitudes as low as -0.1, which followed an earthquake of magnitude 5.0 on November 16, 1964, in the San Andreas fault zone, was monitored in detail by three temporary stations at distances less than 15 km and by the surrounding telemetry array. Nearly all of the 35 shocks clustered in a focal region of about 4 km diameter at a depth near 12 km showed uniform first motion radiation patterns. First motion fault plane solutions are consistent with the right lateral transcurrent motion characteristic of the San Andreas fault. Exceptions to this pattern in the focal region occurred near the times of two large aftershocks, apparently on another fault about 5 km away. D.B.V.

7175 **McGrain, Preston.** Some economic aspects of Kentucky's geologic mapping program [abs.]: Mining Eng., v. 18, no. 8, p. 40, 1966.

6887 **McGuire, Odell S.** Population studies of the Ostracode genus *Polytylites* from the Chester Series: Jour. Paleontology, v. 40, no. 4, p. 883–910, illus., 1966.

This paper presents an integrated quantitative study of the ontogeny and phylogeny of species of the ostracode genus *Polytylites* based on about 1,600 specimens from the Chester Series of southern Illinois and western Kentucky. Examples of phyletic size increase, proterogenesis, and paedomorphosis are described; phyletic growth, in this example, probably resulted from specific evolutionary pressures rather than from the general selective advantages usually presumed to accrue to larger size. An empirical scheme of morphologic comparison is developed to establish intrageneric relationships. Evidence suggests that variability of growth factors is due to changing allometric patterns rather than to overall retardations and accelerations of growth. The taxonomy of the group is reviewed, and one new species, *Polytylites websteri*, is erected.—Author's abstract

6822

6844 **McLaughlin, R. B.** Amateur investigations of Miocene arthropods from the Mojave Desert, California: Microscope and Crystal Front, v. 15, no. 3, p. 96–105, illus., 1966.

The arthropods are found in calcareous nodules in the Barstow Formation in the Calico Mountains. Formic acid solution is used to process the nodules, and a microscope is required for detailed study of individual specimens. The nodules are quite prolific, and some of the rarer types of arthropods, not described in U.S.G.S. Prof. Paper 294G, are found; descriptions and pictures are included.—E.S.L.

6855

6829 **McLeroy, Carol Ann; Anderson, Roger Y.** Laminations of the Oligocene Florissant Lake deposits, Colorado: Geol. Soc. America Bull., v. 77, no. 6, p. 605–618, illus., table, 1966.

The predominant type of lamination, which averages 1 mm in thickness, consists of alternating diatomite and sapropel; a second type, which averages 8 mm in thickness, consists of graded tuff lamina overlain by one or more diatomite–sapropel couplets; a third type consists of inversely graded pumice layers (1.5 cm thick) sporadically interbedded with diatomite–sapropel couplets. Each diatomite–sapropel couplet represents a 1-year varve; the diatomite laminae may represent accumulations of spring diatomite blooms, and the sapropel late summer and early fall accumulations of other plankton. The nature and preservation of the Florissant laminations indicate a chemically stratified lake with a circulating, slightly alkaline upper layer and a stagnant, relatively acidic, oxygen-depleted lower layer.—H.C.W.

6875

6966 **McManus, Dean A.; Hanson, Larry G.; Baker, James V.** A sample splitter for moist, saturated, or suspended sediment: Jour. Sed. Petrology, v. 36, no. 2, p. 632–635, illus., 1966.

A new sample splitter for moist or muddy sediment samples includes a homogenizing and a splitting unit. Difficulties inherent to hand splitting of wet samples are avoided. Sufficiently precise splits are obtainable.—R.A.C.

McNellis, J. M. *See* Morgan, C. O. 7206

7057 **Medearis, Kenneth.** Coupled bending and torsional oscillations of a modern skyscraper: Seismol. Soc. America Bull., v. 56, no. 4, p. 937–946, illus., tables, 1966.

6722

A structural dynamics analysis is made for the 43-story Wells Fargo Building in San Francisco, which is subject to dynamic coupling. With three possible vibratory motions per story, the problem involves 129 degrees of freedom. Using normal mode theory in conjunction with a matrix formulation of the governing complex differential equations, frequency and vibratory mode solutions are obtained with the aid of a digital computer.—D.B.V.

7078 **Melchior, Paul.** The Earth tides: New York and London, Pergamon Press, 458 p., illus., tables, 1966.

This textbook for advanced students is divided into 3 parts. Part 1 (8 chapters) discusses theories and types of tides, treatment of potential in principal waves, theory of combination of ordinates, calculations of drift and amplitudes and theoretical phases of waves, and methods of harmonic analysis and electronic data processing. Part 2 (10 chapters) examines Love's numbers, deflection and deviations of the vertical, variations in intensity of gravity, tangential linear deformation, cubic expansion of the crust, tides and periodic fluctuations in Earth speed, results of observations, geophysical, and geological problems, and international organization for study. Part 3 (4 chapters) examines tides of an elastic Earth, rheology of Earth and tides; diurnal tides and astronomic nutations, and dynamic effect of a liquid core. An appendix covers solid tides on the Moon; a bibliography of 834 entries is included.—V.S.N.

6822 **Melson, William G.; Switzer, George.** Plagioclase-spinel-graphite xenoliths in metallic iron-bearing basalts, Disko Island, Greenland: Am. Mineralogist, v. 51, nos. 5–6, p. 664–676, illus., tables, 1966.

The xenoliths are remarkably similar to reconstituted shale xenoliths in basaltic rocks from other localities except for the presence of graphite and the unusually low Fe content of the spinels, the latter being evidently related to the low oxygen fugacity of the magma in contact with graphite. The xenoliths are very similar in mineralogy from specimen to specimen indicating complete equilibration with the magma. They support the idea of origin of the metallic iron by reduction of basaltic magma by carbonaceous sedimentary rocks.—E.H.R.

6855 **Menard, H. W.** Permanency of continents and ocean basin lineations: Nature, v. 210, no. 5037, p. 725, 1966.

Carr (1966) recently proposed that the close correspondence between lineations on continents and the ocean floor and a theoretical shear net calculated by Vening Meinesz (1947) militates against the hypothesis that continents have drifted since Precambrian times. However, the Vening Meinesz shear net shows little correspondence with the whole pattern of enormous faults discovered on the sea floor in the past 15 years, and should be allowed to rest in peace; what could be fruitful would be further application of the pioneering ideas and techniques developed by Vening Meinesz for the analysis of global shear patterns resulting from possible changes in rate of rotation and polar wandering, indicated by geophysical data.—D.B.V.

6875 **Merriam, Daniel F.** Geology and the computer: New Scientist, v. 26, no. 444, p. 513–516, illus., 1966.

Use of the computer in treating geological data is grouped into the categories of data processing and problem solving. Data storage and retrieval have been adapted by the petroleum industry, and smaller systems are in operation for retrieval of geochemical, paleontological, and stratigraphic data and to facilitate library work. Quantitative methods of factor analysis (especially for study of sediments), time-series analysis (to introduce order into irregular or erratic appearance of data for meaningful interpretation), and regression or trend analysis (to accentuate structural features of less than regional magnitude) are some of the multivariate methods previously avoided because of the amount of mathematical calculation involved. Further applications of quantitative techniques utilizing computers are suggested.—M.C.M.

6722 **Merrihue, Craig; Turner, Grenville.** Potassium-argon dating by activation with fast neutrons: Jour. Geophys. Research, v. 71, no. 11, p. 2852–2859, illus., tables, 1966.

The K-Ar age of a mineral can be determined on the basis of measurement of 270-year Ar-39 produced by the K-39(n,p) reaction when a potassium-bearing mineral is irradiated by fast neutrons. Wänke and Konig (1959) first described such a method, and Merrihue (1965) suggested using the mass spectrometer to determine the Ar-39 and radiogenic Ar-40. It is shown here how the method may be usefully extended by observing variations in the isotopic ratio with temperature during gas release, a technique similar to the correlated release technique used in

I–Xe dating. Some preliminary data obtained on several meteorites are presented.—D.B.V.

Meyrowitz, Robert. *See* Young, E. J. 6939

7158 **Michelson, Robert A.** Prospecting for uranium: Colorado School Mines Mineral Industries Bull., v. 9, no. 4, 9 p., illus., table, 1966.

Future needs for uranium will depend largely on power reactor programs now being considered. Past discoveries of uranium, and its occurrence in primary deposits are reviewed. The discussion on its source, transportation, precipitation, and preservation in sedimentary rocks is illustrated with diagrams. The history of uranium exploration is given and the various methods used described, with emphasis on the geochemical techniques and radiation detectors. Future trends are predicted.—E.S.L.

Mickey, Wendell V. *See* Jordan, James N. 6705

Mielke, James E. *See* Long, Austin. 6944

6639 **Milici, R. C.; Greenberg, S. S.; Jones, Clark.** Paragonite-bearing phyllites in the central Virginia Piedmont: Southeastern Geology, v. 7, no. 3, p. 111–119, illus., table, 1966.

About 15,000 feet of phyllite, argillite, subgraywacke and graywacke, and some greenstone and quartzite were mapped between volcanic rocks of Precambrian Catoctin Formation and base of an Ordovician(?) volcanic unit in eastern Albemarle and western Fluvanna Counties, Va. X-ray diffraction analyses and thin-section studies permitted recognition of a stratigraphyic unit composed of interbedded muscovite-chlorite-paragonite-quartz phyllites within the metasedimentary sequence. The paragonite-bearing unit is believed to correspond to the Candler Formation of earlier workers. Comparison of chemical analyses of paragonite-bearing phyllites with weathered volcanic ash and pumices indicates that the phyllites may have been produced by metamorphism of very fine-grained sedimentary material derived from deeply weathered volcanic terrain.—*from* Authors' abstract

Millard, Richard C. *See* Czamanske, Gerald K. 6859

Miller, R. D. *See* Moore, B. J. 7192

7093 **Milne, A. R.** A seismic refraction measurement in the Beaufort Sea: Seismol. Soc. America Bull., v. 56, no. 3, p. 775–779, illus., 1966.

Results are presented of an unreversed refraction profile made in August 1965 north-northeast of Point Barrow, Alaska, at the southern edge of the Beaufort Deep. Three P-wave velocities of 2.40, 4.40, and 7.47 kmps are indicated. The first two are associated with layers 2.50 and 8.68 km thick, respectively. The third, though lower than the velocity usually associated with mantle arrivals, is consistent with a dip of the mantle plane to greater depths in the south-southwest direction. This conclusion is indicated also by the 15-km crustal thickness, which if oceanic is thicker than usual. There is no evidence of the normally encountered 6.5-kmps oceanic layer.—D.B.V.

6943 **Moberly, R., Jr.; McCoy, F. W., Jr.** The sea floor north of the eastern Hawaiian Islands: Marine Geology, v. 4, no. 1, p. 21–48, illus., tables, 1966.

Data on geomorphic features north of the major Hawaiian Islands which reflect the interplay of processes of volcanism, isostatic adjustment, and sedimentation are reviewed. The crust below the Islands has subsided 2–6 km under the shield volcanoes, and downwarping of the adjacent sea floor has included formation of the Hawaiian Deep; the Hawaiian Arch northeast of the Deep represents a broad upwarping. Sediments in the Deep reflect these geologic processes. Terraces around the islands are evidence of subsidence, and prominent ridges are extensions of rifts of active or recently dormant volcanoes. An area of irregular topography, extending

nearly across the Deep, may include a number of volcanoes. The floor 150 km north of Maui, the proposed Mohole site, appears to be an area of typical oceanic crust.—V.S.N.

Moh, G. *See* Kullerud, G. 6637

6771 **Mongin, Denise.** Affinités des Mollusques du Bathonien du Maroc avec ceux du Jurassique moyen d'Amérique du Nord [abs.]: Soc. Géol. France Compte Rendu 1966, no. 6, p. 234–235, 1966.

7192 **Moore, B. J.; Miller, R. D.; Shrewsbury, R. D.** Analyses of natural gases of the United States, 1964: U.S. Bur. Mines Inf. Circ. 8302, 144 p., tables, 1966.

Analyses for helium and other components are reported for 419 samples of natural gas collected in 1964 as part of a continuing survey of helium resources. Samples from gas and oil wells in 20 states total 391; 28 samples are from pipelines in 6 states.—E.R.L.

Moore, G. W. *See* Davis, S. N. 7055

Moore, George W. *See* Palacas, James G. 7112

7022 **Moore, Paul B.** Reply to Prof. D. J. Fisher [1966 discussion of "Hühnerkobelite crystals . . .", by P. B. Moore, 1965]: Am. Mineralogist, v. 51, nos. 5–6, p. 939–940, 1966.

Nomenclature dividing the iron manganese alluaudites into end members includes hühnerkobelite, with ferrous iron predominant, varulite with manganous manganese predominant, and alluaudite with ferric iron predominant. This nomenclature is consistent with usage in System of Mineralogy (Palache, Berman, Frondel, 1951).—M.L.L.

7083 **Moore, William J.; Curtin, G. C.; Roberts, R. J.; Tooker, E. W.** Distribution of selected metals in the Stockton district, Utah, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C197–C205, illus., 1966.

Spectrographic analyses of bedrock and oxidized surficial materials from the Stockton district in northeastern Utah indicate a zonal distribution of metals spatially related to an intrusive center of Tertiary age. Largely coextensive areas of locally high bismuth–copper–molybdenum concentrations define a central zone; lead–zinc areas of greater lateral extent partly overlap the central zone; locally high arsenic–antimony (and boron?) concentrations characterize the outer zone, with boron extending beyond the limits of significant known mineralization. Silver is erratically distributed in the area studied. The present distribution of metals at Stockton apparently reflects hypogene environmental controls.—Authors' abstract

7051 **Morehouse, David F.** The solubility of Galena dolomite in cave waters [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 95, 1966.

7206 **Morgan, C. O.; Dingman, R. J.; McNellis, J. M.** Digital computer methods for water-quality data: Ground Water, v. 4, no. 3, p. 35–42, illus., 1966.

The digital computer is used on a routine basis in the ground-water program in Kansas for tasks ranging from the listing of water-quality data in tabular and publishable form to statistically and graphically analyzing a mass of data. In the past year a number of computer programs have been developed using an IBM-7040 computer to store, retrieve, and manipulate data. Several programs are described. It is estimated that the use of these will save several man-months during a ground-water study and greatly reduce the error inherent in the manual manipulation of data.—E.S.L.

6801 **Morgan, Thomas.** History of coal mining in Montana, *in* Montana Coal Resources Symposium, 1st, 1964, Proc.: Montana Bur. Mines and Geology Spec. Pub. 36, p. 3–5, illus., 1966.

Lewis and Clark mentioned the presence of coal seams along the Missouri in 1805. In 1865, three small mines were operating, and the first important one opened two years later. The history of the mines is given by counties. In 1944, coal production reached a peak of 4,920,000 tons, but in 1963, only 364,000 tons were produced from 36 small mines.—E.S.L.

6908 **Morgan, W. Jason.** Reply [to criticism by Talwani and others of "Gravity anomalies and convection currents—[Pt.] 2, The Puerto Rico Trench and the Mid-Atlantic Rise"]: Jour. Geophys. Research, v. 71, no. 14, p. 3607–3608, 1966.

In reply to criticism by Talwani and others (ibid., p. 3602–3606) Morgan states that two basic sets of hypotheses are at issue. Details of geologic data of different regions have been successfully interpreted on the basis of the static model, while the dynamic model offers the possibility of relating these separate regions in a worldwide scheme. Though it is admitted that viscosity is not the appropriate rheology parameter for the Earth, the assumption of viscous flow permits an analytical solution; the viscous model is useful as a starting point, revealing features that require nonlinear treatment. Specific objections raised by Talwani and others will be answered in a subsequent paper on layered viscosity.—D.B.V.

7218 **Moritz, Helmut.** The computation of the external gravity field and the geodetic boundary-value problem, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 127–136, illus., 1966.

Three methods are described and compared for computing the gravity field outside the Earth, which is not a level surface. For practical purposes the best method is the free-air reduction to sea level by which solutions are affected in two steps: downward continuation of Δg from the physical surface to sea level, and computation of the external gravity field using simple spherical formulas. The latter is a process of upward continuation in which the irregularities of the Earth's surface are taken fully into account.—V.S.N.

6785 **Morley, Harold T.** Memorial to Robert Jennings Riggs (1888–1965): Geol. Soc. America Bull., v. 77, no. 6, p. P109–P111, portrait, 1966.

Moss, M. L. *See* Farrah, G. H. 6980

Mowatt, Thomas C. *See* Hower, John. 6989

6692 **Mueller, Bruce E.** Use of stereograms in high school earth science: Jour. Geol. Education, v. 14, no. 1, p. 33–34, table, 1966.

As a substitute for an extensive field trip and endless map exercises in order to give the secondary school student a third dimension in the study of geomorphology, the Science Department at Harlem High School, Loves Park, Ill., uses stereograms. Only three out of 400 students of average ability have failed to see the stereo image. Photos are protected within plastic sheets, bound in ring-type notebooks, in sets enough for half the largest class; each set consists of 60 stereograms, available, with information on each, from the University of Illinois. Grouped by subject matter, these are listed in the table, giving catalog numbers. Airphotos from other sources may be supplemented.—G.D.C.

7217 **Mueller, Ivan I.** (reporter). External gravity field of the Earth, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 115–120, 1966.

Advances in rocket and artificial satellite techniques have made necessary practical methods of calculating the gravity vector at certain elevations in space from data observed on the ground, and of the gravity vector on the ground or on some reference surface from data observed in space. Methods used in computation of the normal gravity field, of gravity disturbances, of gravity anomalies, and of undulations and deflections are considered. A bibliography of 41 entries is included.—V.S.N.

6741 **Mueller, Stephen; Landisman, Mark.** Seismic studies of the Earth's crust in continents—[Pt.] 1, Evidence for a low-velocity zone in the upper part of the lithosphere: Royal Astron. Soc. Geophys. Jour., v. 10, no. 5, p. 525–538, illus., 1966.

It is shown that there are a number of new reasons for reconsidering the question of velocity reversals in the crust. The main conclusion is that the concept of a low-velocity zone in the lithosphere deserves thorough attention. It is suggested that the near-constancy of the intercept time at the shotpoint of certain strong second arrivals observed in refraction measurements is intimately related to the reproducibility of large normal-incidence deep crustal reflections produced by an abrupt velocity increase at 9–12 km; their interpretation requires the presence of a low-velocity zone overlying a layer whose velocity is markedly greater than that in the channel and at least 0.2 kmps higher than that above the channel. Other evidence is cited to support the presence of this low-velocity channel.—D.B.V.

Mueller, Stephen. *See* Landisman, Mark. 6742

6799 **Mulligan, Robert.** Geology of Canadian tin occurrences (Report and Map 32-1964): Canada Geol. Survey Paper 64-54, 22 p., illus., table, 1966.

No deposits are being mined primarily for tin in Canada. Several hundred tons per year have been produced as a by-product from lead-zinc-silver-iron ores of Kimberley, British Columbia; there has been active exploration and development in Charlotte County, New Brunswick; small amounts of cassiterite have been recovered from gold placers in the Yukon; and a little mining has been done in Manitoba and Nova Scotia. The map and table include most of the occurrences reported up to 1963. Besides indicating favorable belts and areas, the maps illustrate the remarkable variety in type of tin mineralization and association in Canada. Deposits are loosely classified as placers, pegmatites, quartz veins with and/or without sulfides, disseminated and massive sulfide replacement bodies, and miscellaneous. Their distribution in the Cordilleran Region, Canadian Shield, and the Appalachian Region is given.—G.D.C.

Murthy, V. Rama. *See* Stueber, Alan M. 6974

Muse, W. Ralph. *See* Gammon, Sam W. 6782

Nafziger, R. H. *See* Speidel, D. H. 6820

Nakagawa, H. M. *See* Erickson, R. L. 6896

6995 **Naumann, A. W.; Dresher, W. H.** The morphology of chrysotile asbestos as inferred from nitrogen adsorption data: Am. Mineralogist, v. 51, nos. 5–6, p. 711–725, illus., tables, 1966.

Chromatographic and gravimetric nitrogen adsorption data confirm the view that naturally occurring chrysotile consists of an assemblage of sub-microscopic tubular crystals. Some specimens have solid matter filling the voids between fibrils, and have surface areas and porosities smaller than would be expected from the geometry of the fibrils. Others have little (if any) interstitial material, and have surface areas that correspond to adsorption on essentially all external fibril surfaces. The adsorption data indicate that the central pores of chrysotile fibrils are not available for adsorption, and that the pore structures frequently observed in chrysotile specimens are associated with voids between, rather than channels within, fibrils.—*from* Authors' abstract

6756 **Neuman, Robert W.** A review of radiocarbon dates and archeology on the northern and central Great Plains [abs.], *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 131–132 [1966?].

Newbury, Ray S. *See* Dews, John R. 6817

7104 **Nichols, Thomas C., Jr.; Lee, Fitzhugh T.** Preliminary appraisal of applied rock mechanics research on Silver Plume Granite, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C34-C38, illus., 1966.

A program of preliminary laboratory testing was conducted to determine elastic and physical properties of the Silver Plume Granite and certain types of rock associated with it. Data derived from laboratory tests were used to relate deformation to the structure, fabric, and mineralogy of the rock. Results of this investigation show: (1) how structural features such as strong lineations, foliations, joints, faults, and associated mineralogic variations are related to the deformation and failure of granitic rocks, and (2) how the knowledge of the physical behavior of a rock determined in the laboratory is significant to the engineer when it can be related to the behavior of the rock in the field.—Authors' abstract

Nichols, Thomas C., Jr. *See* Lee, Fitzhugh T. 7202

Nickoloff, Nick. *See* Olson, Edwin A. 6752

6851 **Nicola, Nicholas J.** Long room section mining in salt domes, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 421-431, illus., tables, 1966.

Section mining is unique to salt domes because of limited lateral working area; Cargill's mine at Belle Isle, La., had two problems—ventilation and scales. With increased production of salt, more voids are opened which means more exposure. The long room method will eliminate some dangerous corners prevalent in the room and pillar method. Pre-splitting prior to floor mining is another method to use in forming a smoother wall. The use of more diesel equipment, and ammonium nitrate as an explosive, require proper ventilation.—*from* Author's abstract

6826 **Noad, D. F.** Water analysis—A key to exploration: Canadian Petroleum, v. 7, no. 3, p. 12-18, illus., 1966.

If water analysis is to be used for petroleum exploration, better quality data is needed. Applications discussed include construction of isoconcentration maps and correlation of porous zones. Benzene analysis is one of the more promising tools. Recommendations are made for drillstem test and production sampling, and routine water analysis. It is hoped that these will result in more complete analysis and standardization of the report. The revised information sheet and a new water analysis form are shown.—E.S.L.

6753 **Noakes, John E.; Kim, S. M.; Stipp, J. J.** Chemical and counting advances in liquid scintillation age dating, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 68-92, illus., tables [1966?].

The latest techniques now employed in several benzene liquid scintillation radiocarbon dating laboratories are discussed in detail. Several objections (low chemical yields, possibility of isotopic fractionation, quenching, personnel safety, low counting efficiency, and counter instability) that have been voiced in the past against this method are answered.—E.S.L.

Noble, James A. *See* Taylor, Hugh P., Jr. 6653

7205 **Norris, S. E.; Fidler, R. E.** Use of type curves developed from electric analog studies of unconfined flow to determine the vertical permeability of an aquifer at Piketon, Ohio: Ground Water, v. 4, no. 3, p. 43-48, illus., 1966.

A type-curve method for determining anisotropy of unconfined aquifers, developed from electric analog simulation, is applied to drawdowns observed near a well pumping from a glacial outwash aquifer at Piketon, Ohio. The coefficient of vertical permeability, P_v, averaged 265 gpd per sq ft. Computed drawdown for the pumped well, based on this value, differed by only a small amount from the observed drawdown. The coefficient of storage, determined from type curves for an image well system, averaged 0.20, typical of unconfined aquifers. Application of the

method required a thorough knowledge of geohydrologic controls operating at the test site.—Authors' abstract

6827 **Norvitch, Ralph F.; Lamb, Mary E. S.** Housatonic River basin: U.S. Geol. Survey Massachusetts Basic-Data Rept. 9, Ground-Water Ser., 40 p., illus., tables, 1966.

The area of this report is about 530 sq mi north of the Connecticut-Massachusetts State line and contains the headwaters region of the Housatonic River. It is almost entirely within Berkshire County, Mass., except for 33 sq mi in Columbia County, N. Y. Tabulated are geologic units and their water-bearing characteristics; records and logs of selected wells, test wells, and borings; records of selected springs; chemical constituents in major types of rock; chemical analyses of water from wells and of precipitation samples; major public water-supply systems; and water levels in observation wells.—M.C.M.

Nowacki, W. *See* Wuensch, B. J. 6700

6748 **Nowotny, Ben; Jessen, F. W.** Pressure-temperature effect on spherical cavities in massive salt, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 363-385, illus., table, 1966.

Laboratory experiments were conducted on miniature cavities in 5-inch diameter by 6-inch long, salt cores under a triaxial stress condition of 3,000 psi and a temperature of 130°F. The effects of tri-axial compression and creep were observed. Further, a limited study of thin sections was conducted to determine the relation between the movement of the salt and the patterns of microfractures and cracks. Results indicated that the closure, or decrease in volume, for an empty spherical cavity within a salt dome at this pressure and temperature is in the range of 2.5 percent to 3.0 percent of the initial volume.—*from* Authors' abstract

6660 **Nowroozi, Ali Asghar.** Terrestrial eigenvibrations following the great Alaskan earthquake, March, 1964 [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7261, 1966.

6682 **Nunnally, Nelson Rudolph.** Flood plain morphology along the lower Ohio [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7255, 1966.

6730 **Oakley, Kenneth P.** Radiocarbon dating of fossil hominids, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 277-286 [1966?].

The most important transition in the evolution of the Hominidae, the *Australopithecus-Homo* transition, took place long before the time-level where C-14 dating becomes applicable, but K-Ar dating shows that this occurred between 1/2 and 1 million years B.P. The *Homo erectus-Homo sapiens* transition, 70,000 to 500,000 years B.P., still awaits a suitable method, but a number of problems can be solved by C-14 dating. Four orders of absolute dating, from direct determination of the age of the specimen itself to the age in years inferred on a theoretical basis, are discussed and examples given.—E.S.L.

Oaks, Robert Q., Jr. *See* Coch, Nicholas K. 6873

7142 **O'Brien, Neal R.** A field geology program for high school students: Jour. Geol. Education, v. 14, no. 2, p. 51-53, 1966.

Results of a six-week field geology program indicate that high-ability high school students are capable of understanding the basic principles of geology and doing much of the work previously reserved for college geology majors. Students responded best when emphasis was placed upon use of principles in solving geologic problems in the field. A discussion is presented which includes the type of field problems worked on and suggestions of how to make geology more attractive to high school and college students.—Author's abstract

7050 **Oesch, Ronald D.** Pleistocene bone remains from caves in Perry County, Missouri [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 95-96, 1966.

6754 **Oeschger, Hans; Alder, B.; Loosli, H.; Langway, C. C., Jr.; Renaud, André.** Radiocarbon dating of ice, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 93-101, illus., tables [1966?]. 675

For C-14 dating of polar ice, the CO_2 has to be extracted from 10 to 20 tons of ice to obtain 500 mg of carbon. In order to avoid handling such huge quantities of ice, a special counter has been developed which will measure only 20 to 50 mg of carbon. The counter, and the integrated dating project on ice in the Tuto Tunnel, Greenland, and sample preparation, controls and blanks, and origin of the CO_2, are described and discussed. Preliminary results show an age of about 3,000 yr B.P. at one location, and close to 5,000 yr B.P. at a second.—E.S.L.

Okamura, Arnold T. *See* Koyanagi, Robert Y. 7117

6955 **Oliver, Jack; Ryall, Allan; Brune, James N.; Slemmons, David B.** Microearthquake activity recorded by portable seismographs of high sensitivity: Seismol. Soc. America Bull., v. 56, no. 4, p. 899-924, illus., tables, 1966. 694

The idea that portable seismographs with ultrahigh sensitivity might record a sufficient number of microearthquakes in a short time, say one day, to give a quick measure of the seismic activity of a very local area, was tested at 10 sites in west-central Nevada. Consistently high microseismicity was generally observed in areas of recent faulting, and a lower level (but well above that of aseismic areas) at other sites. Microearthquake activity appears to vary with time. Activity averaged over about 10 hours usually differed by less than a factor of 2 from the overall mean for a site, but in one case swarms of events persisted more than a day. The method appears promising as a technique for monitoring current tectonic activity.—D.B.V.

6707 **Oliver, Jack E.** The Upper Mantle Project—Plans for the future: Am. Geophys. Union Trans., v. 47, no. 2, p. 369-372, 1966. 673

A brief account is given of the history of the Upper Mantle Project, including national and international activities to date, and the kinds of activities (domestic and international cooperative programs) that should be included in the future United States program are indicated. A close relationship of the U.S. Upper Mantle Project and the 10-year outline in the report "Solid-Earth Geophysics—Survey and Outlook" is emphasized.—D.B.V.

6925 **Olsen, Edward; Fredriksson, Kurt.** Phosphates in iron and pallasite meteorites: Geochim. et Cosmochim. Acta, v. 30, no. 5, p. 459-470, illus., tables, 1966. 681

Two Ca-free ferrous(manganous) orthophosphates, sarcopside and graftonite, have been found in four fine octahedrites, where they coexist with schreibersite, troilite, and metal. Calculations of $P(O_2)$-T for reactions relating these phases show that the presence of these phosphates is not inconsistent with the degree of reduction encountered in iron meteorites. Similar calculations for magnesium orthophosphate (farringtonite) indicate that the pallasite in which it occurs is somewhat more reduced than the octahedrites. These phosphorus-bearing irons suggest a degree of oxidation close to that of common chondrites.—D.B.V.

6868 **Olsen, Harold W.** Darcy's law in saturated kaolinite: Water Resources Research, v. 2, no. 2, p. 287-295, illus., 1966. 722

Data obtained with a new laboratory technique for measuring the hydraulic conductivity of saturated clays show that Darcy's law is obeyed at low gradients in saturated kaolinite over a wide range of porosities. The new technique involves producing arbitrary constant flow rates through a rigidly confined clay sample, using a multispeed syringe pump, and measuring the gradients induced thereby with a differential pressure transducer. This avoids errors that arise from atmospheric contamination and from long time intervals needed to obtain, conventionally, measurable flow rates. Exceptions to the validity of Darcy's law may occur in extremely fine-grained clays and also where high gradients are present in shallow, unconfined sediments or in granular soils containing small amounts of clay.—*from* Author's abstract

6752 **Olson, Edwin A.; Nickoloff, Nick.** A system for methane synthesis, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 41-49 [1966?].

Methane gas has outstanding advantages for use as a counting gas in C-14 dating. A system for easy, efficient methane synthesis based on that proposed by Fairhall, Schell, and Takashima (1961) is described. The batch reactor designed for synthesis is essentially a pipe mounted vertically with both ends closed. Reactants are introduced through openings in the top, pressure is measured, and an electrical current is supplied to the catalyst heater. The steps involved in the sequence of production and purification of methane are outlined. Quantities of pure methane up to one mole can be made with overall yields of about 95 percent in six hours; personal attention of the technician is required for only one hour.—V.S.N.

6940 **Olsson, Axel A.; Dance, S. Peter.** The Linnaean Olives: Bulls. Am. Paleontology, v. 50, no. 227, p. 215-223, illus., 1966.

Current identifications of neogastropods *Voluta porphyria, V. oliva, and V. ispidula*, as originally assigned by Linnaeus (1758, 1767), have long been in dispute. A proper understanding of these species is important, as each is the type of a genus or subgenus, *V. oliva* of the genus *Oliva* itself. In this critical study of the original specimens, a lectotype (here figured) and type locality are designated for each species: *V. porphyria* Linnaeus = *Oliva porphyria* (Linnaeus), type locality Gulf of Panama (Recent); *V. oliva* Linnaeus = *Oliva oliva* (Linnaeus), synonym *O. ispidula* of most authors, type locality Mindanao, Philippines (Recent); *V. ispidula* Linnaeus = *Agaronia ispidula* (Linnaeus), synonym *Oliva plicaria* Lamarck, 1811, type locality Gironde, France (Burdigalian Miocene).—V.M.J.

6735 **Olsson, Ingrid U.** New experience on C^{14}-dating of tests of Foraminifera, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 319-331, illus., tables [1966?].

Three possible sources for errors in C-14 dating of Foraminifera are being examined at the Uppsala laboratory: contamination by foreign material in sediments which show no trace of reworking, contamination during preparation, and contamination during storage. Results are discussed, and shown in tables and a graph. Ages of inorganic material from the Caribbean, Atlantic, and Mediterranean are tabulated.—E.S.L.

6815 **Opdyke, N. D.; Wensink, H.** Paleomagnetism of rocks from the White Mountain plutonic-volcanic series in New Hampshire and Vermont: Jour. Geophys. Research, v. 71, no. 12, p. 3045-3051, illus., table, 1966.

Samples were collected at 17 sites in gabbros, monzonites, and diorites of the White Mountain plutonic-volcanic series (dated as 180 m.y.). No useful information was obtained from the diorites. The directions of stable magnetization are well grouped, with both normal and reversed directions present. The mean directions for 12 sites are D = 358.5°, I = 59°, R = 11.9, and K = 110, yielding a pole at lat 85.5° N., long 124.5° E. with p = 4.5°, m = 6°. Samples from two sites in the gabbro from Mount Ascutney in southeastern Vermont (125-135 m.y. old) gave pole positions in agreement with other Upper Jurassic-Cretaceous poles from North America.—D.B.V.

7224 **Orlin, Hyman.** (editor). Gravity anomalies—Unsurveyed areas—Symposium, Ohio State Univ., Columbus, Ohio, 1964, Papers: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), 142 p., illus., 1966.

The 17 papers included in this volume were presented to the symposium under the following four topics: existing surface gravity material, the extension of the gravity net to the unsurveyed areas of the Earth—statistical methods, the extension of the gravity net to the unsurveyed areas of the Earth—geophysical methods, and external gravity field of the Earth. Each section is introduced by a brief summary statement from the reporter. The individual papers are cited separately.—V.S.N.

Ovenshine, A. Thomas. *See* Crowell, John C. 6647

Ozard, J. M. *See* Russell, R. D. 7077

Padan, John W. *See* Howard, Thomas E. 7168

6936 **Pahaut, P. E.** Les sols marnolithiques et alluvionnaires des plaines côtières de la presqu'île du nord-ouest de la République d'Haïti, Pt. 1 [with Dutch, English, and German abs.]: Pédologie, v. 16, no. 1, p. 75–133, illus., tables, 1966.

This soil survey is based on a study of 235 profiles to a total depth of 335 cm, and an analysis of samples in the Soils Laboratory. The parent materials and principal soils are discussed, and criteria for differentiation tabulated. Geologically four rock complexes are distinguished in Haiti: the volcanic massif, the central massif (paleogenic limestones), coastal lowlands (neogenic marnoliths), and the plateau of Bombardopolis and the Atlantic coastal range (Pleistocene coral-reef limestones). Ten typical soil profiles are described and analyses given. A soil map will be drawn after analyses have allowed definition of types.—E.S.L.

7029 **Pakiser, L. C.** Parkfield earthquakes of June 27–29, 1966, Monterey and San Luis Obispo Counties, California—Preliminary report, U.S. Geological Survey investigations: Seismol. Soc. America Bull., v. 56, no. 4, p. 967, 1966.

The events of June 27 and following days were recorded in the epicentral region by a three-component short-period seismograph on a ranch between Cholame and Parkfield; shortly after the earthquakes eight additional portable stations were set up in a rectangle extending about 12 mi along the San Andreas fault and 5 mi on both sides of it. Seven quadrilaterals of survey markers were also installed, which have indicated slippage rates of up to 0.1 inch per day. A fault length of 17 mi of continuous ground breakage is being mapped, and relations of structural failure to foundation conditions are being studied.—D.B.V.

7112 **Palacas, James G.; Swanson, Vernon E.; Moore, George W.** Organic geochemistry of three North Pacific deep-sea sediment samples, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C102–C107, illus., tables, 1966.

Analyses of two samples, one taken about 150 mi northwest of Hawaii, and the other about halfway between the Aleutian Islands and the Hawaiian Islands, showed a nearly identical organic and inorganic composition, indicating a similar environment of deposition and history of diagenesis. The third sample, taken from the Aleutian Trench, south of the Aleutian Islands, showed significant differences and was characterized by the largest amount of organic carbon (0.34 percent), humic acids (1,145 ppm), and amino acids (180 ppm).—Authors' abstract

Parker, F. L. *See* Empson, F. M. 6696

7190 **Patrick, Joseph L.** Geologic exploration in 1965 *in* The search for ore: Mining Eng., v. 18, no. 2, p. 69–71, 1966.

The upward trend in geologic exploration in the United States has continued in 1965. Successful search for metallic and non-metallic minerals is dependent on combined geochemical, geophysical, and geologic methods with higher quality of laboratory and field support. Government and industry activities are summarized.—C.B.D.

6725 **Patterson, Dan W.** Nuclear decoupling, full and partial: Jour. Geophys. Research, v. 71, no. 14, p. 3427–3436, illus., tables, 1966.

Pressure histories on the walls of cavities in salt of suitable size for decoupling sources are calculated and used in computing motion of the walls. Calculated displacement potentials are compared with measured potentials to give close-in decoupling ratios for the Salmon and Gnome events. A difference between reduced displacement potentials suggests that the Gnome measurement may have been in the inelastic region or was influenced by stronger horizontal propagation. Reduced displacement potentials calculated for shots of 100 t and 0.5 and 1 kt in a cavity

volume for 100-t decoupling are 0.47, 5.0, and 45 m^3 respectively compared to 80 m^3 for a fully tamped 100-t shot.—D.B.V.

7140 **Paull, Richard A.** In defense of geological libraries: Jour. Geol. Education, v. 14, no. 2, p. 57–59, table, 1966.

Most academic geologists are convinced of the value of a geological library in the immediate vicinity of their classrooms, offices and laboratories. The Geology Department of the University of Wisconsin surveyed 27 geology departments in the United States and Canada to determine the library facilities available to them; results summarized in a table show type of library and status of librarian, and eminent satisfaction substantiated by selected comments of respondents. Concerted opinion was that a central library destroys both the ability and the incentive to browse through current literature. In addition, a librarian interested in earth sciences can aid in the systematic routine of acquisition of materials.—G.D.C.

6737 **Pearson, F. J., Jr.** Use of C^{13}/C^{12} ratios to correct radiocarbon ages of materials initially diluted by limestone, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 357–366, illus. [1966?].

Carbonate in ground water is selected as an example in discussion of materials which generally cannot be dated successfully by C-14. The dateable portion of this carbonate is from the CO_2 of the soil air which is isotopically equivalent to plants. This is diluted with dead carbonate from limestone. Two reactions controlling the carbonate chemistry of water are discussed and a formula derived for the ratio of the soil-air carbonate concentration to the total carbonate concentration. Water from the Eocene Carrizo Sand in Atascosa County, Tex., is studied to test this scheme. The agreement between the corrected C-14 ages and the hydrologic data is gratifying.—E.S.L.

7017 **Pearson, F. J., Jr.; Davis, E. Mott; Tamers, M. A.** University of Texas radiocarbon dates IV: Radiocarbon, v. 8, p. 453–466, table, 1966.

Dates reported represent routine measurements made since preparation of Texas III list (1965). Known-age bone samples from Texas, dated to determine suitability of the material for C-14 dating, are tabulated. Geologic and paleontologic samples were obtained from Texas, Mexico, Oregon, and Wisconsin; archeologic samples from Texas, Louisiana, and Mexico.—M.C.M.

Peck, Dallas L. *See* Skinner, Brian J. 6770

6884 **Pedder, A. E. H.** The Upper Devonian gastropod *Orecopia* in western Canada: Palaeontology, v. 9, pt. 1, p. 142–147, illus., 1966.

The distribution of *Orecopia* is reviewed. Apart from a possible Famennian occurrence in Nevada, the genus as presently known is confined to the Frasnian of western North America and eastern Europe and is represented by five described species. *Orecopia mccoyi and O. uchtensis* are refigured and a new species, *O. cotei*, is erected for specimens from British Columbia and the Northwest Territories. It is suggested that the Tathlina Formation of the southern Northwest Territories may be late, rather than middle Frasnian.—Author's abstract

6894 **Pegler, A. V.** An examination of the fracturing of rocks by hydraulic pressure, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 70–102, illus., tables, 1966.

The property of aeolotropy [anisotropy], that is, inherent directional characteristics where present in rocks, should be made use of in mining and such operations to design stable orientations of openings as well as to define optimum drilling and breaking directions. Where these properties are definable by laboratory technique, they should be used to define preferred fracturing planes by strike and dip, and the azimuth or direction of preferred strain propagation induced by hydraulic fracturing. Using reflective photoelastic techniques, the basis of prefracture analysis

as far as directional characteristics are concerned is outlined, and results are given of tests on samples of Potsdam Sandstone from Gananoque, and of Lyndhurst Marble from near Kingston, Ontario.—G.D.C.

6915 **Peirce, H. Wesley; Gerrard, Thomas A.** Evaporite deposits of the Permian Holbrook Basin, Arizona, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 1–10, illus., table, 1966.

In east-central Arizona near the southern margin of the Colorado Plateau, between the Mogollon Rim and the Defiance region, evaporite deposits of principal interest occur in the "upper" Supai Formation which ranges from 450 to 1,300 feet in thickness. In its thicker portions the evaporite, largely halite, has an aggregate thickness of up to 485 feet. Subsurface halite occurs over an area of 2,300 sq mi. Exploration drilling has verified the existence of a sylvite-bearing zone high in the series. The evaporites resulted from evaporation of sea water that transgressed northwestward across an active tectonic zone at least partially coincident with the trend of the present Mogollon Rim. Clastic influx from the north eventually completed the filling of the Permian Holbrook Basin.—*from* Authors' abstract

7040 **Pelletier, B. R.** Development of submarine physiography in the Canadian Arctic and its relation to crustal movements, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 77–101, illus., 1966.

Submerged dendritic drainage of Tertiary age on a single land mass, modified by valley glaciers, is supported by data from soundings, grab samples, and cores in the Arctic Archipelago region. A drainage divide is inferred from a submarine ridge separating the Arctic Ocean from Baffin Bay. Bottom coastal topography establishes submergence; post-Pleistocene emergence is seen in raised beaches, sedimentary texture and faunal changes in cores. Over-all vertical movement of 2,000 feet is not explained by simple ice loading and release of pressure after melting. Aside from faulting in Baffin Bay, it appears that a general tectonic force acted over the entire archipelago, and may still be in operation. Northern Greenland and the Arctic Islands appear to have identical physiographic and tectonic histories—structural control of original drainage and vertical, not horizontal, crustal movement since Pleistocene.—G.D.C.

6904 **Pepin, Robert O.** Heavy rare gases in silicates from the Estherville mesosiderite: Jour. Geophys. Research, v. 71, no. 11, p. 2815–2829, illus., tables, 1966.

Kr in Estherville silicates is a mixture of primordial and spallation components, and Xe a mixture of primordial, spallation, and fission components, and possibly some radiogenic Xe-129. The average Xe isotopic composition for the spallation Xe is given; the relative abundance of Xe-131 is significantly higher than predicted. Extinct radioactivity chronologies and the question of concordant formation intervals are examined for Estherville and Pasamonte. I-Xe and Pu-Xe formation intervals for Pasamonte are probably concordant at about 220±40 m.y. The isotopic composition of Pasamonte fission Xe is estimated.—D.B.V.

Perkins, H. F. *See* Gibbs, J. A. 7147

6997 **Peters, Tj.; Luth, W. C.; Tuttle, O. F.** The melting of analcite solid solutions in the system $NaAlSiO_4$-$NaAlSi_3O_8$-H_2O: Am. Mineralogist, v. 51, nos. 5–6, p. 736–753, illus., tables, 1966.

Analcite melts incongruently to albite, nepheline, and liquid above an invariant point at 4.75 Kb and 665+5°C. At the invariant point analcite has an anhydrous composition $Ab_{50}Ne_{42}$, containing 15.5 percent H_2O. Small amounts of potassium (about 2 percent K_2O) can be taken up by the analcite solid solutions. It is suggested that analcite phenocrysts in some extrusive and hypabyssal rocks can form in the small temperature region where analcite coexists with liquid and that groundmass analcite could crystallize from differentiates of alkali rich magmas within the experimentally determined stability field of analcite.—Authors' abstract

7000 **Petersen, Ole V.** Crossed axial plane dispersion in epididymite: Am. Mineralogist, v. 51, nos. 5–6, p. 916–919, illus., table, 1966.

X-ray powder data and variation of the three indices of refraction and 2V for wavelengths 4,150 to 6,800 angstroms are given for epididymites from Narssarssuk and Ilímaussaq, Greenland.—B.C.H.

7193 **Peterson, Edward C.** Titanium resources of the United States: U.S. Bur. Mines Inf. Circ. 8290, 65 p., illus., tables, 1966.

The major titanium ores are ilmenite and rutile. Domestic reserves of ilmenite now economically exploitable total 50.3 million tons of TiO_2 and occur associated with gabbro and anorthosite in New York and Virginia, and in placer deposits in Florida, South Carolina, and New Jersey. Resources of ilmenite not now economically recoverable contain 51.1 million tons of TiO_2 and occur in California, Colorado, Minnesota, Montana, Oklahoma, Oregon, Rhode Island, and Wyoming. Small deposits of rutile are estimated to contain only 1.8 to 2.1 million tons of TiO_2, and are scattered in several states. Only deposits in Florida and Virginia are now mined. Typical mining and beneficiation methods are described. Uses are reviewed.—C.S.B.

7108 **Pettyjohn, Wayne A.** Eocene paleosol in the northern Great Plains, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C61-C65, illus., 1966.

A lateritic soil profile of probable late Eocene age crops out in widely separated localities in the northern Great Plains. Especially well developed in western South Dakota and northwestern Nebraska, it is characterized by vivid purple, yellow, and greenish-gray sediments directly underlying the Chadron Formation of the White River Group of Oligocene age. The stratigraphic units on which the soil profile formed range in age from Early or Late Cretaceous to late Eocene.—Author's abstract

6749 **Peyfuss, Kurt F.; Jacoby, C. H.** Measurement of salt pillar movement, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 46-56, illus., 1966.

With respect to dry salt mining operations, observations of convergence were carried on by a telescoping tube gauge, to measure dilation and shortening of salt pillars under load stress. Work with a stratascope indicated that the amount of separation in overlying bedding planes was a major contribution to the total apparent movement. From the data shown here, and from other mines, it was concluded that the number of rooms side by side has much more influence in increasing pillar stress than was indicated in photoelastic model tests, and that both convergence rate and dilation rate can give a meaningful description of the structural behavior of a mine.—G.D.C.

Phelan, Thomas. *See* Cooper, G. Arthur. 7144

6697 **Philbin, P. W.; Vargo, J. L.** Aeromagnetic map of parts of the Ironwood and Wakefield quadrangles, Gogebic County, Michigan and Iron and Vilas Counties, Wisconsin: U.S. Geol. Survey Geophys. Inv. Map GP-578, scale 1:62,500, 1966.

6698 **Philbin, P. W.; Vargo, J. L.** Aeromagnetic map of parts of the Thomaston, Carp River, North Ironwood and Little Girls Point quadrangles, Gogebic and Ontonagon Counties, Michigan and Iron County, Wisconsin: U.S. Geol. Survey Geophys. Inv. Map GP-579, scale 1:62,500, 1966.

Pierce, A. P. *See* Delevaux, M. H. 7082

Pilkey, O. H. *See* Heezen, Bruce C. 7045

7020 **Powell, Richard L.** Development of a karst valley in Monroe County, Indiana [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 94-95, 1966.

6760 **Pratt, A. R.; Heylmun, E. B.; Cohenour, R. E.** Salt deposits of Sevier Valley, Utah, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 48–58, illus., 1966.

Salt beds outcrop in Sevier and Sanpete Counties and are mined sporadically in the valley of Sevier River near Redmond. The only outcrops of pre-Quaternary salt beds in Utah, they occur in the Arapien Formation of Middle Jurassic age. The Sevier River, flowing through areas of Arapien salt, once flowed into Pleistocene Lake Bonneville, and was probably an important contributor to the salinity and mineral content of Great Salt Lake. Rocks in the area are complexly folded, and there is evidence of salt flowage and structural collapse. Over 200 feet of bedded salt have been observed; analyses indicate it to be halite, reddened by a few impurities. X-ray diffraction which indicated the presence of sylvite was not confirmed by chemical analysis of the same specimens.—G.D.C.

6930 **Press, Frank.** Seismological information and advances, *in* Advances in Earth science—Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 247–286, illus., tables, 1966.

Developments in seismic instrumentation have extended frequency response, spatial coverage, and use of digital data acquisition systems. Linear arrays in massive field surveys show a thin crust in the Great Basin, implying a decrease of 5 percent in mantle density below the M-discontinuity. More precise traveltimes, using data from nuclear explosions, have led to better epicenter location and information concerning layering in the Earth's core. Propagation of long waves and free oscillations is reviewed, with a tabular summary of theoretical and observed modes. Among results are: rapid increase in velocity at depths below 350 and 450 km; revision of mantle densities below 1600 km; a new seismic parameter for Q-depth; first-time instrumental recovery of source dimensions and faulting rate. Strain and tilt meters to recover a deformation field at great distances may lead to earthquake prediction and detection of nuclear explosions.—G.D.C.

Press, Frank. *See* Lehner, Francis E. 6956

6641 **Price, Van; Ragland, Paul C.** Trace metals in quartz by atomic absorption spectrophotometry: Southeastern Geology, v. 7, no. 3, p. 93–100, illus., tables, 1966.

Quartz from various sources was analyzed by atomic absorption spectrophotometry for Li, Zn, Cu, Ag, Au, and Fe. This relatively new method of analysis is simple, rapid, and highly sensitive. Results indicate that the metal content of vein quartz is a good indicator of the total metallic mineralization of the vein.—Authors' abstract

7204 **Priem, H. N. A.; Boelrijk, N. A. I. M.; Verschure, R. H.; Hebeda, E. H.; Lagaay, R. A.** Isotopic age of the quartz-diorite batholith on the island of Aruba, Netherlands Antilles: Geologie en Mijnbouw, v. 45, no. 6, p. 188–190, table, 1966.

Results are presented of Rb-Sr and K-Ar age determinations on biotite or whole rock samples of the quartz-diorite batholith on Aruba. It is concluded that this rock crystallized 73±3 m.y. ago, confirming Westermann's (1932) dating of the batholith as Upper Cretaceous.—D.B.V.

7189 **Proctor, Paul D.** Geological engineering in 1965 *in* The search for ore: Mining Eng., v. 18, no. 2, p. 71–74, illus., table, 1966.

Applications of engineering geology to dam, tunnel, and highway sites and landslide areas were numerous. Beach and stream erosion studies continued. Investigations of unstable building sites in areas of dense population and underground storage facilities increased. Hydrogeologic studies consisted of discovery and recovery of ground water sources and disposal of waste fluids into rock reservoirs.—C.B.D.

6976 **Przybylowicz, Edwin P.; Zuehlke, Carl W.** Silver, *in* Treatise on analytical chemistry—Pt. 2, Analytical chemistry of inorganic and organic compounds, V. 4, Sec. A: New York, Interscience Publishers, p. 1–69, tables, 1966.

The occurrence of silver is reviewed briefly and methods of detection and identification are given. Physical and chemical properties are summarized both for the metal and for 13 compounds, and the separation and determination procedures are described for various methods.—G.D.C.

6764 **Pyke, D. R.** Geology of Montauban–Colbert area, Champlain and Portneuf counties [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 545, 15 p., table, geol. map, 1966.

Consolidated rocks of the map-area are Precambrian. The metamorphosed sedimentary and basic volcanic rocks of the Grenville Series have been intruded by igneous rocks ranging from granite to peridotite which underlie about half the area. Locally the structure is quite complex. Zinc and lead were mined from the Montauban ore zone from 1910–1955, gold and molybdenum occur in places, and several other mineral possibilities are present.—E.S.L.

Rader, L. F., Jr. *See* Hawley, C. C. 7119

Rader, Lewis F., Jr. *See* Swanson, Vernon E. 7196

7019 **Radforth, N. W.** The ancient flora and continental drift, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 53–70, illus., table, 1966.

To paleobotanists, three assertions in the drift theory seem plausible: past climatic zones have been moved by influences other than ice advances; zones have been warped by differential rates of movement of land masses; major separations began in the Tertiary south of the present equator and in the Mesozoic north of it. Of four great floras involved in drift, Euroamerican flora are found in the Appalachian and eastern seashore zone. The magnitude of spread of the Glossopteris flora in the Southern Hemisphere supports paleomagnetic evidence for supercontinent Gondwanaland. Morphologic trends and adaptive relations conform to changes in latitude suggested by paleomagnetism. Resemblance of Devonian microfossils in Canada to Eurasian favors pre-Carboniferous continental contiguity. Ellesmere Island is the focal point of interest in Devonian as pre-drift and late Mesozoic as post-drift.—G.D.C.

6828 **Ragan, Donal M.; Hawkins, James W., Jr.** A polymetamorphic complex in the eastern Alaska Range: Geol. Soc. America Bull., v. 77, no. 6, p. 597–604, illus., table, 1966.

A polymetamorphic complex in the Rainbow Mountain–Gulkana Glacier area, south of the Denali fault, is related structurally and lithologically to the Birch Creek Schist north of the fault. The polymetamorphic rocks are largely metaigneous types that occur in the following proportions: ultramafic, 10 percent; mafic, 25 percent; and leucocratic, 65 percent. Preliminary work reveals four major metamorphic events that are based on sequence of mineral assemblages, and on structural and stratigraphic relations. These events and their tentative ages are: (1) granulite facies metamorphism, Precambrian; (2) amphibolite facies metamorphism and migmatization, Paleozoic(?)–Precambrian(?); (3) synkinematic greenschist metamorphism, pre-Devonian; and (4) syn- or post-intrusive recrystallization in greenschist facies marginal to quartz diorite stocks, Mesozoic.—R.A.L.

Ragland, Paul C. *See* Price, Van. 6641

Raitt, G. *See* Siebert, H. 7191

Ralph, Elizabeth K. *See* Stuckenrath, Robert, Jr. 7015

6971 **Ramesam, V.** Improved methods of heavy mineral separation and counting suitable for fine-grained sandstones: Jour. Sed. Petrology, v. 36, no. 2, p. 629–631, illus., 1966.

Modification of the centrifuge tube makes it possible to separate heavy minerals and recover light and heavy fractions in separate containers. Performing heavy

mineral grain counts by traverse method is just as precise and more efficient than counting by fields.—R.A.C.

6792 **Ramspott, L. D.** Volcanism, tectonism, and plutonism in the western United States—Discussion [of paper by James Gilluly, 1965]: Geol. Soc. America Bull., v. 77, no. 6, p. 663–665, 1966.

Article by Gilluly (Geol. Soc. America Spec. Paper 80, 1965) fails to recognize several possibilities, based primarily on lead-alpha determinations, of Paleozoic ages of western plutons. This now is confirmed by lack of geologic control in many instances and the possibility of metamorphic effects on K–Ar dates where established.—J.J.H.

Randolph, Philip. *See* Werth, Glenn. 6704

Randolph, Philip. *See* Rawson, D. 6724

7195 **Rapp, Richard.** (reporter). The extension of the gravity net to the unsurveyed areas of the Earth—Statistical methods, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 49–52, 1966.

Statistical techniques for estimating gravity anomalies suggested by de Graaff-Hunter, Molodenskiy and others, Hirvonen, Kaula, Baussus, Rapp, and Moritz are reviewed. All computations described have been carried out on the IBM 7094, and production programs are available that can be used for point prediction and mean anomaly predictions with accuracy estimates in any size square; in practice, the mean anomaly predictions are limited to a maximum size square of 30′. Other available techniques include the development of known anomalies into spherical harmonics and application of the surface-fitting concept to one-dimensional samples such as anomaly profiles. The statistical methods may also be used for analytic evaluations or nonmanual evaluation of gravimetric dependent quantities such as statistical predictions for use in deflections of the vertical computation.—V.S.N.

7132 **Rasetti, Franco.** New Lower Cambrian trilobite faunule from the Taconic sequence of New York: Smithsonian Misc. Colln., v. 148, no. 9 (Pub. 4662), 52 p., illus., 1966.

The new faunule was found in regularly bedded limestone on a hill southeast of North Chatham, in Columbia County, N. Y. The most common fossils are small inarticulate brachiopods, but hundreds of trilobite specimens representing about 30 species, largely new and belonging to new genera, are the object of this study. The size of the trilobites is unusual, in that the Eodiscids are large for the family, while all the Olenellids are of small size. The structure in the area is exceedingly complicated so that only a tentative succession of faunules can be suggested. Systematic descriptions of the new species are given and many are illustrated—E.S.L.

6924 **Rau, Jon L.** (editor). Second symposium on salt—V. 1, Geology, geochemistry, mining; V. 2—Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geological Society, V. 1, 443 p., illus., tables; V. 2, 422 p., illus., tables, 1966.

These volumes include 72 of the 78 papers presented in a symposium at Cleveland, Ohio, on May 3–5, 1965, and the abstracts of five papers for which manuscripts were not available. Many of these are cited individually.—G.D.C.

6761 **Raup, Omer B.** Bromine distribution in some halite rocks of the Paradox Member, Hermosa Formation, in Utah, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 236–247, illus., 1966.

Bromine content was determined for 301 samples of halite from a well core in Cane Creek anticline, Grand County. The stratigraphic interval includes halite units of four depositional cycles of the upper part of the Paradox Member, samples of which were collected at 2-ft intervals. The bromine values, ranging from 80 to 350 ppm, were plotted with respect to their stratigraphic positions. The profiles show a

systematic increase in bromine from bottom to top of each of the four Pennsylvanian salt beds; they are grossly similar, but differ in detail. It can be inferred from the steady increase that there was neither a major change in depositional conditions nor apparent metamorphism of the salt.—G.D.C.

6724 **Rawson, D.; Randolph, Philip; Boardman, C.; Wheeler, V.** Post-explosion environment resulting from the Salmon experiment: Jour. Geophys. Research, v. 71, no. 14, p. 3507–3521, illus., table, 1966.

The 5-kt Salmon nuclear detonation created a nearly spherical cavity 17.4±0.6 m in radius and vaporized and melted about 5.4×10^6 kg of rock (salt), forming a puddle which took 24–32 days to recrystallize. Most of the explosive energy was distributed as heat within 45 m of the shot point, and radioactivity increased above background to 64 m. The wall rock was highly microfractured, with some macrofractures, especially at 39–50 m below shot point. The puddle was highly fractionated. The cavity could be used for experimental investigation of full or partial decoupling; however, the surrounding material is less competent than before, and its present strength and stress distribution are not known.—D.B.V.

7080 **Reed, Bruce L.; Hemley, J. J.** Occurrence of pyrophyllite in the Kekiktuk Conglomerate, Brooks Range, northeastern Alaska, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C162–C166, illus., 1966.

Pyrophyllite occurs in the matrix of the Upper(?) Devonian or Mississippian Kekiktuk Conglomerate. Pyrophyllite may have formed from the alteration of kaolinite or other high-alumina clay minerals during low-grade metamorphism.—Authors' abstract

6856 **Reed, George W., Jr.; Allen, Ralph O., Jr.** Halogens in chondrites: Geochim. et Cosmochim. Acta, v. 30, no. 8, p. 779–800, illus., tables, 1966.

Cl, Br, and I contents of several classes of chondrites are reported. Auxiliary information confirms U and Te concentrations and I/Te ratios previously reported. Cl and Br are positively correlated; most chondrites fall on correlation lines with Cl/Br ratios between 20 and 100. Br and I exhibit a simple correlation; most meteorites fall near a line with a Br/I ratio of about 1. Abundances derived from the data support the concept that Type I carbonaceous chondrites have best retained a primordial complement of solar system matter. The astrophysical and meteoritic abundances of Cl based on O agree reasonably well, whereas those on Si differ greatly.—D.B.V.

7062 **Reed, John C.** The Arctic Institute of North America—Yesterday and today: Arctic, v. 19, no. 1, p. 19–31, illus., 1966.

After reviewing the first few years following 1945, this chapter deals with current work of the Institute. Most funding is from government sources through a variety of grants and contracts, a few of which are singled out. The Office of Naval Research of the U.S. Navy helped with the Arctic Research Laboratory at Point Barrow, Alaska, compilation of the Arctic Bibliography, and several symposia on Arctic subjects. The U.S. National Science Foundation supported several projects of the International Geophysical Year, and has sponsored teacher education in Arctic fields. The National Research Council of Canada recognizing the importance of polar exploration has given unlimited support. The Institute has an outstanding polar library, a substantial publications program, and expanded educational activities in the cooperation with McGill University; research is the heart of the organization.—G.D.C.

7079 **Reed, M. G.; Scott, A. D.** Chemical extraction of potassium from soils and micaceous minerals with solutions containing sodium tetraphenylboron—[Pt.] 4, Muscovite: Soil Sci. Soc. America Proc., v. 30, no. 2, p. 185–188, illus., tables, 1966.

The samples were placed in NaCl–BaTPB solutions at 25°C, and the precipitated K was separated with boiling NH_4Cl solution that contained $HgCl_2$. With this

method 96 percent of the K was removed in $<10\mu$ muscovite in 16 weeks. This was the maximum amount that was extracted.—E.S.L.

Renaud, André. *See* Oeschger, Hans. 6754

Reynolds, P. H. *See* Ulrych, T. J. 6818

7136 **Rice, Charles L.** Geologic map of the Martin quadrangle, Floyd County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-563, scale 1:24,000, section, text, 1966.

Coal, gas, and oil are the principal mineral resources of Martin quadrangle. Coal has been mined commercially for about 50 years primarily from the Upper Elkhorn beds; all coals of the region are high-volatile A bituminous and potentially coking coals. The quadrangle is within the Big Sandy gas field, and gas is obtained from several formations, mainly from Ohio Shale. Small quantities of oil are found also. Other resources include sand and gravel of alluvium along larger streams.—M.C.M.

7134 **Richards, Adrian F.** Geology of the Islas Revillagigedo, Mexico—[Pt.] 2, Geology and petrography of Isla San Benedicto: California Acad. Sci. Proc., 4th ser., v. 33, no. 12, p. 361–414, illus., tables, geol. map, 1966.

San Benedicto lies at the intersection of four local ridges thought to be fissures where the Clarion fracture zone crosses a range of submarine volcanoes. Compared to others of the Revillagigedo archipelago, its very narrow insular shelf is poorly developed. Principal landforms are large eroded trachytic domes older than late Pleistocene, and two pyroclastic volcanoes of recent origin. The trachybasalt and trachyandesite flows on the island and northward offshore submarine ridge, and accessory sodic rhyolite ejecta from Volcán Bárcena, 1952–53, are described. The increasing age and decreasing quantity of silicic lavas and active volcanism from east to west in the Revillagigedos appear related to convection under the East Pacific Rise, accounting for similarity of sodic rhyolites found on San Benedicto and elsewhere in the Pacific Basin.—G.D.C.

6643 **Richards, Horace G.** Notes on five marine Pleistocene localities in northeastern North Carolina: Southeastern Geology, v. 7, no. 3, p. 135–139, 1966.

Mollusks are reported from five localities in northeastern North Carolina. A locality near Washington suggests a Pleistocene oyster reef, while one near Terra Ceia suggests slightly more saline water. Faunas from Swan Quarter and Fairfield suggest a more open sea. All the above are referred to the Pamlico Formation of Sangamon age. Shells from Water Lily in Currituck County are regarded as part of an Indian midden.—Author's abstract

6928 **Ringwood, A. E.** The chemical composition and origin of the Earth, *in* Advances in Earth science—Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 287–356, illus., tables, 1966.

The Earth has retained primordial abundances of elements not readily volatile under high-temperature reducing conditions. In a model based on this hypothesis, the metallic core contains 20 percent of elemental silicon; the upper mantle is concluded to have a 3:1 ratio of peridotite to basalt. Compared with composition of the entire mantle, derived from chondritic abundances, a distinctive differentiation pattern is revealed. Trace elements not entering major mantle minerals have been concentrated into the upper mantle by crystal-liquid fractionation. High siderophile abundances imply a core formed in chemical disequilibrium with the mantle. Multi-stage theories of reduction before Earth accretion are rejected in favor of direct single-stage accretion in the growing Earth. Volatile elements escaped with the dense primitive atmosphere; non-volatile silicates precipitated in a disk which broke up to form the Moon.—G.D.C.

6929 **Ringwood, A. E.** Mineralogy of the mantle, *in* Advances in Earth science Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 357–399, illus., tables, 1966.

The mantle may be subdivided into three distinct regions on the basis of seismic velocity distributions. The Upper Mantle (M to 400 km), dominantly olivine, pyroxenes, and garnet, is believed to be chemically zoned, with dunite–peridotite just below the continental M-discontinuity, passing downward into primitive "pyrolite" with four distinct mineral assemblages. In the Transition Zone (400 to 900 km) a series of major phases increase total density almost 20 percent; at 400 km magnesian pyroxenes break down into forsterite plus stishovite; at 500 km forsterite has spinel structure, becoming denser between 600 and 900 km, probably chiefly ilmenite. At 900 km the phases are too closely packed for further changes, and the Lower Mantle is essentially homogeneous down to 2,900 km; density and elastic ratio agree closely with independent geophysical estimates.—G.D.C.

6689 **Roberson, Herman E.; Durisek, E. Jane.** Concepts of crystal chemistry illustrated in the introductory mineralogy laboratory: Jour. Geol. Education, v. 14, no. 1, p. 12–14, illus., 1966.

Students in the introductory mineralogy course at Harpur College [Binghamton, N. Y.] perform a series of experiments dealing with solid-solution phenomena. KBr–KCl crystals with various molar ratios (KBr/KCl) are grown and examined by employing standard optical and X-ray diffraction techniques. The relationship of the physical properties to structure and chemical composition is emphasized. This crystal-chemical study is introduced without omitting standard beginning mineralogy laboratory material.—Authors' abstract

6694 **Robert, Jean-Louis.** Geology of Mount Vallières-de-Saint-Réal area, Gaspé North county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 549, 21 p., table, geol. map, 1966.

Most of the bedrock of the area is made up of Silurian–Devonian sedimentary rocks overlying, in the north, Cambrian and Ordovician metasedimentary and metavolcanic rocks. Granitic masses were injected into the sedimentary rocks at various periods, the Mount Vallières-de-Saint Réal plug being the largest body. The older rocks form tight east-west trending folds. Alteration zones and mineralization are discussed. The results of geochemical prospecting of stream sediments are shown on the geologic map.—E.S.L.

6963 **Roberts, Albert; Hawkes, I.** Reply to E. Heidecker's discussion [of "The determination of in-situ stress and strain using photoelastic techniques", 1964]: Felsmechanik u. Ingenieurgeologie, v. 4, no. 1, p. 57–59, 1966.

Heidecker's criticisms apparently are directed toward techniques described by C. L. Emery, which formed the basis for the authors' earlier work. They no longer use the plastic patches in the manner described by Heidecker, but do use a biaxial gauge with the core-relief technique. Less success was had with coatings than was reported by Emery, but rocks tested came from coal mines of open pits where strata were fractured. There has been more success with crystalline sediments of chemical origin and with metamorphic igneous rocks, but emphasis has been on strains due to elastic rebound rather than time dependent relaxation. In the case of the quartzite rock illustrated in this original paper, the anisotropy was not pronounced, the stress field in the roof beds is biaxial.—G.D.C.

Roberts, R. J. *See* Moore, William J. 7083

Robin, G. de Q. *See* Evans, S. 6865

6774 **Robinson, Enders A.** Multichannel z-transforms and minimum-delay: Geophysics, v. 31, no. 3, p. 482–500, illus., 1966.

The concept of minimum delay (minimum phase) is an important link in tying together the deterministic and statistical approaches to seismology. It is shown how this concept can be extended to the multichannel case by using multichannel z-transforms. With this approach the theory of multichannel filter can be built up in an analogous manner to single-channel theory. In particular, multichannel predictive deconvolution can be applied to multitrace seismograms to eliminate reverberations. Because multichannel filters can exhibit trace-to-trace and record-

to-record correlations, better results could be obtained in many applications where single-channel digital filters are now being used.—D.B.V.

Rodda, J. L. *See* Kohls, D. W. 7034

6957 **Rodgers, P. W.** A phase sensitive parametric seismometer: Seismol. Soc. America Bull., v. 56, no. 4, p. 947–959, illus., 1966.

The steady-state response characteristics of a seismometer do not depend on the phase of the input. A phase-dependent response is obtained by parametric excitation of the seismometer, which is achieved with an electromagnetic spring. A theory is developed for this device and comparisons are made with experimental data. The construction of the seismometer and its application are discussed.—Author's abstract

Rogers, C. L. *See* Byers, F. M., Jr. 7150

6938 **Rogers, John J. W.; Adams, John A. S.** Fundamentals of geology: New York, Harper and Row (Harper's Geoscience Series), 424 p., illus., tables, 1966.

Subject matter of this textbook is limited specifically to physical geology in the classical sense. The 16 chapters are: nature of geology; Earth's size and shape; gravity, mass, and density; seismology; composition of the Earth; components of the Earth's crust—petrology and mineralogy; sedimentary rocks; igneous and metamorphic rocks; processes at the Earth's surface; structural geology; rivers; secondary sculpturing agents and processes; oceans; some major Earth processes; economic geology—geologic aspects; and man in geologic perspective. Charts given in the appendix subdivide 21 common minerals into groups with distinct physical properties.—M.C.M.

6726 **Rogers, Leo A.** Free-field motion near a nuclear explosion in salt—Project Salmon: Jour. Geophys. Research, v. 71, no. 14, p. 3415–3426, illus., tables, 1966.

Shock pressure, position, velocity, and material displacement have been calculated for the 5-kt Salmon nuclear detonation by extrapolation of results from the Gnome event and also on the basis of measurements of the physical properties of material in the shot region. Agreement between calculated and observed data for peak pressure and peak velocity, shock wave arrival times, displacement of salt at 300 m, and ground surface motion directly above the shock is discussed. The calculations based on measured physical properties in general agree better with the observations than do the extrapolated values. The central cavity apparently grew to a radius of 24 m during the initial dynamic stage and then contracted to 17 m after the shot.—D.B.V.

Rogers, M. A. *See* Swain, F. M. 6926

Romberg, Frederick E. *See* Berg, Robert E. 6789

6784 **Rouse, John T.; Behre, Charles H., Jr.** Memorial to Walter Herman Bucher (1888–1965): Geol. Soc. America Bull., v. 77, no. 6, p. P99–P107, portrait, 1966.

7143 **Roy, Chalmer J.** Let's teach geology as the *science* of the earth: Jour. Geol. Education, v. 14, no. 2, p. 47–50, 1966.

Few secondary school teachers have the background or time to discover for themselves the fascination of learning which is reaching even the kindergarten. Reports of a GEO-Study of education recognize: continued emphasis on description and taxonomy rather than concepts, principles, and the challenge of unsolved problems; failure to present stimulating and provocative laboratory exercises. Traditional elementary geology courses fail to provide a synthesis of recent developments in earth science. Geology must be broad enough to encompass world-wide cooperative investigations of the planet and its environment in space. A new concept-oriented text *Investigating the Earth*, laboratory manual, and teacher's guide are being tested by 30,000 students.—G.D.C.

Rubey, William W. *See* Heard, Hugh C. 7065

6716 **Rubin, Meyer; Hanshaw, Bruce B.; Back, William.** Ground water applications of C–14 dating [abs.], *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF–650652, p. 589 [1966?].

6661 **Russell, Dale Alan.** The skull of American mosasaurs [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7261, 1966.

7077 **Russell, R. D.; Kanasewich, E. R.; Ozard, J. M.** Isotopic abundances of Pb from a "frequently mixed" source: Earth and Planetary Sci. Letters, v. 1, no. 2, p. 85–88, illus., 1966.

The discussion outlines the inaccuracy in the interpretation of Pb–isotope ratios of individual samples on the assumption of adequate averaging by successive geologic cycles. The frequently mixed source model for Pb–isotope abundances is best approximated by a two stage model. This is illustrated by the geochronology of anomalous leads of Broken Hill, Australia. Independent K–Ar and Rb–Sr measurements, using a two stage model (4,500 – 1,600 and 1,600 – 510 m.y.) simulated with a digital computer, were studied. Ten additional events were introduced within the second stage. Except for the first, at every stage the U–238/Pb–204 ratio for each sample was drawn at random from a lognormal distribution with mean value of 8.98 and 67 percent of values lying between one–third and three times this value. The isotope ratios were found to lie along secondary isochrons.—M.N.

6813 **Russell, R. J.** Coral cap of Barbados: Koninkl. Nederlandsch Aardrijksk. Genoot. Tijdschr., ser. 2, v. 83, no. 3, p. 298–302, illus., 1966.

Barbados marks the end of structural trends that extend from Venezuela through the Northern Range of Trinidad and nearby Tobago. The latest Tertiary Oceanic Series rests on the highly deformed Scotland Series of earliest Tertiary. Above the Oceanic, the coral cap forms a series of terraces separated by sharp escarpments, the crests of which are formed by a reef facies. Behind the crests, the terraces exhibit fauna of deeper water, no species of which is not living today. The reefs formed during periods of rest following periods of rapid upheaval. This uplift is still going on, and the present fringing reefs are very young. Karst topography is developed on all terraces, the higher ones being more advanced.—E.S.L.

6831 **Rust, B. R.** Late Cretaceous paleogeography near Wheeler Gorge, Ventura County, California: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1389–1398, illus., table, 1966.

Twenty sq mi of Upper Cretaceous sedimentary rocks north of Ventura, Calif., were examined for sedimentary structures. On the basis of these features, Rust interprets the fine–grained deposits as deposition at considerable depth on a nearly level sea floor and the interbedded persistent conglomerates as deposition by mass movement into deep water spreading across the flat sea floor. Thus these sediments were chiefly transported and deposited by marine turbidity currents which varied considerably in scale.—A.E.R.

Ryall, Alan. *See* Oliver, Jack. 6955

6998 **Ryall, William R.; Threadgold, Ian M.** Evidence for $[(SiO_3)_5]_{infinity}$ type chains in inesite as shown by X–ray and infrared absorption studies: Am. Mineralogist, v. 51, nos. 5–6, p. 754–761, illus., table, 1966.

Examination of the infrared absorption spectra of the single chain silicates, augite, hedenbergite, pectolite, wollastonite, bustamite, rhodonite and pyroxmangite shows that the number of peaks in the 530–775 cm^{-1} region is an indicator of the number of tetrahedra in the repeat unit of the chains. The infrared spectrum of inesite . . . (as a result of this study now classified as a pyroxenoid), together with evidence from single crystal X–ray studies, indicates it to be made up of single chains with five silicon–oxygen tetrahedra per repeat unit.—Authors' abstract

Sams, Richard H. *See* Crowell, John C. 6647

Sandell, Ernest B. *See* Kolthoff, I. M. 6981

6781 **Sato, Motoaki; Wright, Thomas L.** Oxygen fugacities directly measured in magmatic gases: Science, v. 153, no. 3740, p. 1103–1105, illus., 1966.

An electrochemical device was used to measure the fugacity of oxygen (f_{oxygen}) in holes drilled through the crust of Makaopuhi lava lake, Kilauea Volcano, Hawaii. Results obtained within six months of the lake formation show that log f_{oxygen} normally varies linearly with the reciprocal of the absolute temperature, and that chemical changes occurring in the cooling tholeiitic basalt are reflected in the f_{oxygen} values measured in the holes.—Authors' abstract

6996 **Scarfe, C. M.; Luth, W. C.; Tuttle, O. F.** An experimental study bearing on the absence of leucite in plutonic rocks: Am. Mineralogist, v. 51, nos. 5–6, p. 726–735, illus., tables, 1966.

It is suggested that the reaction leucite↔hexagonal kalsilite+potash feldspar and compositional limitations of the rocks explain the absence of leucite in plutonic alkaline rocks. The above reaction has been located experimentally in the system kalsilite–silica–water. It extends from an invariant point involving the three solids plus liquid and gas at 8.4 kb and 750°C. Leucite is stable on the high temperature side.—E.H.R.

Schaffer, W. F., Jr. *See* Empson, F. M. 6696

6861 **Scheffer, Herman W.** The occurrence of germanium in willemite: Geochim. et Cosmochim. Acta, v. 30, no. 8, p. 837–838, 1966.

Appreciable quantities of Ge, ranging from 47 to 350 ppm, are reported for crystals of willemite from several localities in New Mexico and Utah. The three methods used to determine Ge gave essentially equivalent comparable results.—D.B.V.

Schell, W. R. *See* Fairhall, A. W. 7007

6910 **Schell, William R.; Fairhall, A. W.; Harp, G. D.** Measurements of carbon-14 in known age samples and their geophysical implications, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 397–414, illus. [1966?].

A carbon-14 laboratory was set up and calibrated to achieve the highest degree of precision and accuracy possible. Samples of sequoia wood, dendrochronologically dated, were used to confirm or negate some effects attributed to changes in cosmic-ray flux, etc. Preparation, counting, and computation techniques are described. C-14 age became younger relative to true age as samples became older. Effect of climatic change on atmospheric C-14 is discussed and a temperature equation derived which allows solution of the system, atmosphere–ocean, with respect to C-14 concentration in wood samples. Results show that atmospheric C-14 is slowly decreasing in a linear manner. Two explanations are suggested—the half-life may be underestimated, or a direct correlation may exist between change in climate and atmospheric C-14/C-12 ratio.—E.S.L.

6675 **Schindler, Rolf.** Die Standardgesteinsproben des ZGI—Erste zusammenfassende Betrachtung der Spurenelementanalysierung der Standardgesteine des ZGI, Berlin, und ihr Vergleich mit den amerikanischen Gesteinen G-1 und W-1 [with English and Russian summ.]: Zeitschr. Angew. Geologie, v. 12, no. 4, p. 188–196, illus., tables, 1966.

The preparation of standard rocks by the Central Geological Institute is briefly reviewed, together with a comparison of hitherto known results obtained by spectral, chemical, and neutron-activation analyses of some trace elements, as well as with a discussion of their scattering. The results are compared with the development experienced by the analytical treatment of the American rocks G-1 and W-1, which, after 17 years, can be regarded as practically finished.—Author's summary

6970 **Schlee, John.** A modified Woods Hole rapid sediment analyzer: Jour. Sed. Petrology, v. 36, no. 2, p. 403–413, illus., 1966.

Sand fractions in sediment samples from the Atlantic Continental Shelf will be analyzed for grain-size distribution with an improved sedimentation tube. The instrument measures size by means of a pressure differential between two columns of water having a common head. Pressure rises abruptly when sand is added, and decreases as particles of different sizes settle. Pressure variation recorded on a moving chart constitutes a cumulative frequency graph of the grain-size distribution. A wide range of sizes in a sediment causes grains of most size classes to settle more rapidly than predicted by Stokes Law. Calibration of the instrument results in a settling curve that is parallel to but displaced to the left of the Stokes Law curve over a time base.—R.A.C.

6870 **Schmidt, Klaus.** Nordamerika, [Chap.] B *in* Präkambrium—Handbuch der stratigraphischen Geologie, V. 13, Pt. 1: Stuttgart, Germany, Ferdinand Enke Verlag, p. 10–118, illus., tables, 1966.

With a brief review of the tectonic divisions of North America, the many classifications of the Precambrian rocks as found in the literature are compared for provinces in the Canadian Shield, Greenland, and Interior Lowlands in the central stable region, and for the Appalachian and Cordilleran Systems to the east and west. Photographs illustrate several types of rock, maps show the distribution and chronological divisions, and tectonic relations, and a number of correlation tables are included. References are listed for each geographic division, and a number of quotations are given in German translation in the text.—G.D.C.

Schneider, E. D. *See* Heezen, Bruce C. 7045

Schrodt, Ariel G. *See* Kowalski, Sandra J. 7016

7138 **Schubel, J. R.** A reading course in marine geology: Jour. Geol. Education, v. 14, no. 2, p. 63–65, 1966.

Of all the institutions in the United States offering at least a major in geology, less than 23 percent offer a course in either marine geology or geological oceanography. Because oceans cover nearly 71 percent of the Earth's surface, and because the vast majority of stratified rocks covering 75 per cent of the area of the continents are of marine origin, the geology of the continents cannot be divorced from the geology of the ocean basins. A knowledge of marine geology is essential in interpretation of ancient rocks, in evaluation of existing theories and proposal of new in study of the structure and history of the Earth. As an alternative to the shortage of teachers trained in marine geology, a reading course is suggested, and selected references cited. A slightly modified version has been satisfactorily used for the past two years at Johns Hopkins University in the Department of Oceanography.—G.D.C.

6678 **Schwerdtner, W. M.** Preferred orientation of halite in a "salt seismogram", *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 70–84, illus., tables, 1966.

The orientation pattern obtained on 100 halite grains in rock from the Winnfield Salt Dome is similar to those for the Grand Saline Salt Dome (Clabaugh, 1962). A dynamic analysis of the fabric was made by assuming that salt rock behaves like a rheid during doming. The orientation observed agrees with the hypothetical pattern predicted by the Calnan and Clews theory (1950) for that due to intragranular gliding. Kamb's theory (1959) for syntectonic crystallization predicts a state of preferred orientation dissimilar to the observed fabric pattern. It is concluded that the present state is mainly due to intragranular rotations and that crystallization during or after annealing did not markedly change the deformation pattern.—G.D.C.

Schwerdtner, W. M. *See* Clark, A. R. 6854

Scott, A. D. *See* Reed, M. G. 7079

Scott, James H. *See* Carroll, Roderick D. 7103

6874 **Scurlock, J. R.** Geologic structure map of northeastern Arizona: Phoenix, Ariz., Arizona Oil and Gas Comm., scale 1:375,000 [1966?].

6979 **Sedlet, Jacob.** Radon and radium, *in* Treatise on analytical chemistry—Pt. 2, Analytical chemistry of inorganic and organic compounds, V. 4, Sec. A: New York, Interscience Publishers, p. 219–366, illus., tables, 1966.

Radium is the heaviest member of the alkaline earth group; radon is the heaviest noble gas. Although the properties of the two elements, described briefly in this chapter, differ widely there is a close connection in their analytical chemistry. All isotopes of radium and radon are radioactive, and essentially all determinations of these elements are made by radioactive measurements; references are given for principles and details. Their concentrations in nature vary widely; separation methods are reviewed, and determination procedures are given, illustrating the systems used in analyzing ores and ore-processing residues, water, soil, food, and biological samples, and living bodies. Selected laboratory procedures are described in a little more detail.—G.D.C.

7113 **Segerstrom, Kenneth.** Parícutin, 1965—Aftermath of eruption, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C93–C101, illus., 1966.

In contrast to their earlier catastrophic history, Parícutin volcano and its surroundings were approaching stability in 1965. The pattern and extent of lapilli fans on the outer slopes of the cone and the arrangement of fissures and slump blocks on inner (crater) slopes changed little during 1957–65. Most fumaroles still active in 1965 were in fissures on the crater rim, although the lava field outside the cone still had local hot spots. Increase in the vegetal cover was evident in the crater and on the rim but small on the outer slopes. Llanos along the edge of the lava field produced better crops than previously, or produced for the first time. Discharge of springs outside the lava field declined during 1957–65, reversing an earlier trend. Except on very steep slopes, devastated areas outside the lava field recovered spectacularly, chiefly through revegetation. Human population of the devastated zone was nearly constant during 1957–65.—Author's abstract

Sellmann, Paul V. *See* Brown, Jerry, 7182

7028 **SenGupta, Supriya.** Studies on orientation and imbrication of pebbles with respect to cross-stratification: Jour. Sed. Petrology, v. 36, no. 2, p. 362–369, illus., 1966.

Pebbles in stream deposits may be oriented with their long axes parallel, transverse, or unrelated to direction of current movement. Pebbles in top-set and bottom-set beds tend to lie longitudinally to the flow direction. Those which move by jumping instead of rolling have random orientations and may, in being deposited, disturb the preferred orientation of pebbles that move by rolling. Imbrication of flat pebbles results from removal of sediment supporting the upstream end of a pebble and deposition of sediment under the downstream end, resulting in an upstream dip of the flat pebble surface.—R.A.C.

6745 **Serata, Shosei.** Continuum theory and model of rock salt structures, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 1–17, illus., 1966.

The structural behavior of rock salt specimens tested in the laboratory appears to be quite different from that of actual salt mines; tests on the structural properties have produced significantly different values. In an effort to investigate the cause of these differences, through studies in the laboratory and field, the structural behavior of rock salt was found to be consistent whenever the boundary condition of loading was identical. By treating salt mine structures as part of a continuous medium, the relationship of the structural behavior between the laboratory specimen

and the salt mine was determined. The laboratory specimen was used as a model for actual mine conditions. Application of the model technique in evaluating the safety of an old mine as well as in the design of a new one is discussed.—*from* Author's abstract

6791 **Sever, C. W.** Reconnaissance of the ground water and geology of Thomas County, Georgia: Georgia Geol. Survey Inf. Circ. 34, 14 p., illus., tables, 1966.

Late Eocene Ocala Limestone and Oligocene Suwannee Limestone, principal aquifers of Thomas County, are tapped by domestic, municipal, and industrial wells. Maximum yield varies from about 60 gpm in the northwest to more than 3,000 gpm in the central part of the county. The Tallahatta and lower part of the Lisbon Formations (middle Eocene) contain saline water. Contours drawn on top of the Suwannee Limestone show a northeastward-trending fault with a displacement of as much as 190 feet, with rocks upthrown on the southeast side. Changes in lithology and thickness of lower and middle Miocene sediments indicate that movement occurred during early and middle Miocene time. General absence of the Citronelle Formation (Pliocene) southeast of the fault indicates that faulting may have occurred again during post-Miocene time.—*from* Author's abstract

7100 **Sever, Charles W.** Miocene structural movements in Thomas County, Georgia, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C12-C16, illus., 1966.

Rocks of Oligocene and Miocene age in Thomas County, in the Coastal Plain province in southwestern Georgia, are gently folded and are transected by at least one northeast-trending fault. Maximum displacement along the fault is at least 190 feet and may be somewhat greater. Structural deformation began during Oligocene time, or at least before the Tampa Limestone (early Miocene) was deposited, and continued spasmodically through middle Miocene and possibly through late Miocene time. The trends of the Miocene structures parallel those of late Paleozoic structures in the Appalachian tectonic province in Georgia. The parallel trends suggest that the older Paleozoic structures in some way have controlled the Miocene structures.—Author's abstract

6809 **Sharp, W. W., Jr.** Example of stratigraphic confusion—Type locality of Butler Clay Member of Rockdale Formation (Wilcox Group), Bastrop County, Texas: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1444-1454, illus., 1966.

Clay pits at Butler, northern Bastrop County, are the type locality of the Butler Clay Member of F. B. Plummer (1933). This member is the basal Calvert Bluff Clay Member, which is actually the upper of three members described by Plummer and not the lowest underlying the Simsboro Sand Member as originally described by Plummer. The members proposed by Plummer, except the Butler, are raised to formation rank, and the Hooper Formation, proposed by H. B. Stenzel, has been adopted instead of the Butler Member. Clay beds in the Calvert Bluff and Hooper Formations weather to clay soil which supports prairie grasses and mesquite, whereas the sand beds of the Simsboro Formation weather to a pedalfer soil which supports dense growth of blackjack oak, post oak, and cedar. Thus, it is possible to map these formations in areas of poor outcroppings with some reliability.—S.P.S.

Shaw, William W. *See* Hurd, Donald W. 7180

7084 **Shawe, D. R.** Arizona-New Mexico and Nevada-Utah beryllium belts, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C206-C213, illus., tables, 1966.

Beryllium occurrences of several types in southern Arizona and New Mexico are found in a belt characterized by fluorspar deposits and beryllium- and fluorine-rich igneous rocks. The Arizona-New Mexico area is geologically similar to the Nevada-Utah belt that contains the world's largest beryllium deposits at Spor Mountain, Utah.—Author's abstract

6688 **Shea, James H.** Highlights of 1965 ESCP survey of earth science teachers: Jour. Geol. Education, v. 14, no. 1, p. 9-12, illus., tables, 1966.

To accomplish the objective of the Earth Science Curriculum Project to accelerate and improve the academic preparation of secondary earth science teachers, up-to-date information is continually sought on their number and their preparation. Newly available statistics are presented herewith. It is apparent that the number of adequately prepared teachers is far less than the number currently needed, and many have been "drafted" to do a job for which they are not qualified. Imaginative programs and new curricula are needed in academic preparation for teaching an investigative and interdisciplinary approach to earth science.—G.D.C.

Sheppard, Richard A. *See* Gude, Arthur J., 3d, 6987

7145 **Short, Lester L., Jr.** A new Pliocene stork from Nebraska: Smithsonian Misc. Colln., v. 149, no. 9 (Pub. 4661), 11 p., illus., 1966.

A fossil tibiotarsus from the Lower Pliocene of Nebraska proves to be a new genus and species of fossil stork, *Dissourodes milleri*. This form differs from all (sufficiently known) fossil and modern storks, but shares many features with *Dissoura episcopus* and also *Jabiru mycteria*. Several differences in the condylar head of the tibiotarsus distinguish it from these two storks.—Author's abstract

6965 **Shotts, Reynold Q.** Possible correlation of coal beds on Sand and Lookout Mountains: Alabama Acad. Sci. Jour., v. 37, no. 1, p. 15–21, illus., 1966.

Previous work on the coal beds of Sand and Lookout Mountains is reviewed, and comparative sections are shown. Various possible correlations among these beds in Georgia, Alabama, and Tennessee are discussed. A description of the rocks on Lookout Mountain, quoted by Culbertson (1964) from Denson and Hose, is given with a notation to the effect that Shotts' own observations on Sand Mountain indicate that the descriptions would fit the corresponding units on that mountain.—E.S.L.

Shrewsbury, R. D. *See* Moore, B. J. 7192

6922 **Shuman, A. Cornwell; Fiedelman, Howard W.** Gross imperfections and habit modification in salt crystals, *in* Symposium on salt, 2d—V. 2, Rock mechanics, geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 246–253, illus., 1966.

Gross imperfections in salt crystals are micro- and macro- scale defects as opposed to lattice defects. Mother liquor inclusions (brine cavities in this paper) represent one type; the effect of crystal size and shape on their number is shown. Laboratory tests show that additives reduce brine cavities; heating to high temperatures can remove those which may cause salt caking. Inclusions of solid particles, principally calcium sulfate and calcium carbonate, represent another type, the number of which is a function of salt crystal size, concentration of solid particles in the brine, and particle size of the inclusions. Soluble phosphates added to brine reduce inclusions. Additives also cause crystal habit modification. Vacuum pan salt is an outstanding example of purification by crystallization.—G.D.C.

7191 **Siebert, H.; Raitt, G.** Development of slopes in metamorphic rock: Mining Eng., v. 18, no. 4, p. 77–80, illus., 1966.

Successful highway slope design in metamorphic rocks in Connecticut is determined by structure (jointing, foliation) and mineralogical composition. Drilling, spacing and depth of holes, and loading and detonation of explosives depend on the competency and type of rock.—C.B.D.

6858 **Siegel, A.** Equilibrium binding studies of zinc–glycine complexes to ion-exchange resins and clays: Geochim. et Cosmochim. Acta, v. 30, no. 8, p. 757–768, illus., tables, 1966.

The quantities of trace metals in the sea and their distribution between the solution and various solid phases such as sediments and detritus must to some extent be related to the presence or absence of various complexing agents in sea-water. A secondary consideration is the possibility of interactions between the solid phases

and the products of complex formation. Bearing on this question, results are presented here of uptake studies of trace amounts of Zn on ion-exchange resins and clays, made at 15°C, pH 8.0, in the presence of 0.7 ionic strength mixed electrolyte and varying concentrations of glycine.—D.B.V.

7159 **Siegel, Frederic R.; Dort, Wakefield, Jr.** Calcite-aragonite speleothems from a hand-dug cave in Northeast Kansas [with Spanish abs.]: Internat. Jour. Speleology, v. 2, pts. 1-2, p. 165-169, illus., tables, 1966.

Stalactites, linear stalactitic growths, flowstone, and crusts, from a hand-dug cave in northeastern Kansas (Sec. 2, T2S, R22E) are composed of calcite and aragonite. If the estimated age of the cave is correct, i. e., 150-200 years, the stalactites have grown at a maximum rate of 0.20 to 0.15 mm per year along their vertical axes. All of the speleothems examined contain about one percent strontium (based on qualitative emission spectrograph analyses). Rate of supply and evaporation of the vadose waters may dictate whether aragonite or calcite is the polymorph that precipitates.—*from* Authors' abstract

6706 **Simmons, Gene.** (chairman). Deep drilling on land for scientific purposes: Am. Geophys. Union Trans., v. 47, no. 2, p. 373-378, 1966.

This is the main body of the report of the ad hoc Committee on Deep Drilling for Scientific Purposes, a subcommittee of the U.S. Upper Mantle Committee. Typical problems that may be attacked by deep or very deep (25,000 ft) drilling are discussed, and possible areas to be investigated further as desirable drilling sites are cited. It is recommended that the Upper Mantle Committee endorse a deep drilling program, and take the necessary steps to initiate such a program.—D.B.V.

7101 **Simmons, George C.** Pre-Middle Devonian and post-Middle Devonian faulting and the Silurian-Devonian unconformity near Richmond, Kentucky, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C17-C19, illus., table, 1966.

Two periods of movement on northwest-trending faults are recognized by differences in amount of offset of Silurian and Devonian formations and by the results of pre-Middle Devonian erosion. Initial faulting occurred after deposition of the Crab Orchard Formation, and probably the Bisher(?) Limestone. Subsequent erosion almost completely removed the Bisher(?) and produced a nearly level surface on the Crab Orchard. Consequently, only lower parts of the Crab Orchard remain on upthrown sides of faults; thicker sections are present on downthrown sides. Faulting again occurred after the Boyle Dolomite and the lower part of the New Albany Shale were deposited.—Author's abstract

7102 **Singewald, Q. D.** Description and relocation of part of the Ilse fault zone, Wet Mountains, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C20-C24, illus., 1966.

New data on the Ilse fault zone, a major dislocation in the central Wet Mountains of Colorado, show that it extends northward and joins a fault previously known to cross the Arkansas River 1 1/2 miles west of Parkdale. An ancestral Ilse fault antedated the Cambrian Period; it was a linear zone, variable in width and intensity of deformation, and transected the grain of Precambrian gneiss. Reactivation on a major scale, but not necessarily of equal intensity everywhere, moved the east wall relatively downward during Laramide, or later time. Several strong radioactive anomalies were found north of hitherto reported thorium mineralization in the fault and southeast of it.—Author's abstract

7197 **Sinkankas, John.** Iris-opal from Mexico: Jour. Gemmology, v. 10, no. 3, p. 100-105, illus., 1966.

Hyalite opal, exhibiting iridescence similar to iris-agate, has recently been found at several localities in San Luis Potosí. The outer zones on much of the hyalite were colorless but the cores were smoky, the play of color is much weaker than in precious opal and can be seen only in certain positions beneath a strong light, and specific gravity and refractive index are both very high for hyalite. Experiments

show that the smoky color disappears on heating and that free water is practically absent. Growth bands were counted, and their average width determined on electron-photomicrographs; diffraction from growth bands appears to be the cause of the iris-effect.—E.S.L.

6770 **Skinner, Brian J.; Peck, Dallas L.** The solubility of sulfur in basic magmas [abs.]: Econ. Geology, v. 61, no. 4, p. 802, 1966.

Slemmons, David B. *See* Oliver, Jack. 6955

6673 **Sloan, R. E.; Austin, G. S.** (compilers). Geologic map of Minnesota—St. Paul sheet, bedrock geology: Minneapolis, Minn., Minnesota Geol. Survey, Univ. Minnesota, scale 1:250,000, 1966.

Sloss, L. L. *See* Beckman, W. A., Jr. 6805

6937 **Sloss, L. L.** Orogeny and epeirogeny—The view from the craton: New York Acad. Sci. Trans., ser. 2, v. 28, no. 5, p. 579-587, illus., 1966.

Region-wide unconformities divide the North American craton into six major assemblages of strata termed sequences: Sauk, Tippecanoe, Kaskaskia, Absaroka, Zuni, and Tejas. Their relationship to standard periods and absolute time scale is illustrated by a diagram showing intensity curves of mobile-belt and cratonic orogeny and epeirogeny. Most modern tectonic syntheses distinguish between orogenesis on the craton and that in the mobile belts and their margins; but relationships become obscure when geographic patterns are examined. In epeirogeny, five stages of tectonic behavior are recognized in a cratonic sequence cycle. There seems to be litle control of major elements by the composition, age, or previous tectonic state of basement rocks. Recognition of cratonic tectonics depends on three-dimensional stratigraphic data available from subsurface exploration of interior basins.—G.D.C.

6972 **Smalley, I. J.** The expected shapes of blocks and grains: Jour. Sed. Petrology, v. 36, no. 2, p. 626-629, illus., 1966.

Sedimentary particles are formed by disruption of rocks by physical forces. This random process results in predictable probabilities of occurrence of various particle shapes which may be classified in terms of combinations of three axial lengths, a, b, and c into discs, spheres, blades and rods. The shapes with the highest probability of occurrence fall within the limits of the blade class in which a is greater than b is greater than c. Departures from the expected frequencies of occurrence of the randomly produced shapes indicate nonrandom influences such as the effects on rock fracturing of anisotropic crystal structure and slaty cleavage.—R.A.C.

Smith, C. H. *See* Irvine, T. N. 6649

6668 **Smith, George I.** Geology of Searles Lake—A guide to prospecting for buried continental salines, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 167-180, illus., 1966.

Large saline deposits, free of clastics, formed in Searles Lake, California, during late Quaternary time. In Searles Valley, distribution and stratigraphic relations of exposed lake sediments indicate long periods during which the lakes were large and did not overflow but periodically shrank into small lakes or salt pans; clastic sedimentation was appreciable only near the margins. A high-lake salinity is suggested by fresh-water fossils found only near the main fresh-water inlet, traces of soluble sodium salts throughout the section, and a notable percentage of aragonite in the younger sediments increasing upsection. Chemical stratification of lakes is suggested by such textural and compositional features as black organic marls with coexisting finely crystalline minerals having contrasting solubilities immediately surrounding the saline bodies observed in drill cores.—G.D.C.

6892 **Smith, John D.** The use of rock mechanics in mine design at the Fairport Mine, Morton Salt Company, *in* Symposium on salt, 2d—V. 2, Rock mechanics,

geophysics, evaporated salt, solution mining, underground storage: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 34–45, illus., 1966.

This Ohio mine in Silurian beds is considered to have good mining conditions and relatively stable rock formations but has shown significant floor heaving, pillar rib failure, and roof spalling. A rock mechanics programme was authorized to provide data on movement so that the improved mine design would result in reducing or eliminating these problems. This paper describes the means of accumulating data and presents summaries of measurements obtained and how they were used to determine the improved design and rock movement control. Results of change in direction of mine plan were noted, in a test of two months, to include better fragmentation, no floor heaving, and reduced slabbing and spalling. With extended mining there was some floor heaving but at a reduced rate.—G.D.C.

Smith, Stewart W. *See* Allen, Clarence R. 6949

Smith, Vertie C. *See* Lee, Donald E. 7120

6982 **Smith, W. Everett.** Chromium enrichment in hydrated iron oxide sediments, southeastern Alabama [abs.]: Alabama Acad. Sci. Jour., v. 37, no. 1, p. 130–131, 1966.

Snow, Robert E. *See* Houston, Wesley M. 7178

6654 **Snyder, Frank G.** Precambrian iron deposits in Missouri [abs.]: Econ. Geology, v. 61, no. 4, p. 799, 1966.

6645 **Sørensen, Henning.** På spor af sjaeldne metaller i Sydgrønland—[Pt.] 3, Ilímaussaq-intrusionen—rosinen i pølseenden [with English abs.]: Grønland 1966, no. 6, p. 185–197, illus., tables, 1966.

The strongly per-alkaline nature of the nepheline syenites of the Ilímaussaq intrusion is explained as a result of high-volatile pressure in the magma reservoirs. These rocks are rich in rare elements and minerals. The intrusion formed as one of the latest members of the Gardar province, about 1,000 m.y. ago. Uranium mineralization at Kvanefeld is in the contact zone of roof lavas and the lujavrites which intrude them. The lavas also contain widespread niobium mineralization. The metasomatized lavas and the lujavrite were intruded by a network of coarse lujavritic and analcime veins, and strongly analcitized and enriched in monazite, thorite, and steenstrupine, containing up to 3,000 ppm uranium.—E.S.L.

6773 **Souch, B. E.** (and others). The sulfide ores of Sudbury—Their particular relation to a distinctive inclusion-bearing facies of the "nickel irruptive" [abs.]: Econ. Geology, v. 61, no. 4, p. 801, 1966.

6820 **Speidel, D. H.; Nafziger, R. H.** Retrograde melting in the system Mg-Fe-Si-O [reply to discussion by P. Toulmin, 3d, of 1966 paper]: Science, v. 153, no. 3744, p. 1674, 1966.

The first of Toulmin's comments (ibid, p. 1674) on the report by Speidel and Nafziger (ibid, v. 152, p. 1367, 1966) would be correct if the four-phase assemblages considered could be projected onto the Mg-Fe-Si plane; however, as vapor is present in equilibrium with all the phase assemblages present, and oxygen must also be considered, the relationships for quaternary rather than ternary systems must be used. As for the heat of reaction, all that was intended was a qualitative indication of the energy relationships.—D.B.V.

6710 **Springer, Donald L.** Calculation of first-zone P wave amplitudes for Salmon event and for decoupled sources: Jour. Geophys. Research, v. 71, no. 14, p. 3459–3467, illus., tables, 1966.

Experimentally measured first arrival amplitudes at ranges between 200 and 1,000 km from the Salmon nuclear event agree fairly well with calculations based on a source function derived from Gnome. The first arrival at 200–1,000 km can be treated as a refraction from the M-discontinuity; however, body wave calculations

might give amplitudes of equal consistency. Amplitudes calculated for a fully decoupled 5-kt source show a decoupling of 200. Those from an overdriven cavity source indicate that partial decoupling of 80 can be gained by overdriving a cavity by a factor of 5.—D.B.V.

7060 **Springer, Donald L.** P-wave coupling of underground nuclear explosions: Seismol. Soc. America Bull., v. 56, no. 4, p. 861–876, illus., table, 1966.

P-wave amplitude data for underground nuclear explosions are correlated with detonation energy. Theoretical scaling relationships are verified and relative coupling for various shot mediums is established. An empirical correlation of amplitudes with dry porosity of the detonation medium indicates that a medium with 60 percent dry porosity may couple explosive energy one-fourth or one-fifth as efficiently as does alluvium. The relationship of teleseismic magnitude to explosive yield for various types of low coupling shows that dry porous mediums give a significant reduction of seismic signals generated by underground nuclear explosions.—*from* Author's abstract

6727 **Staley, D. O.** The diurnal oscillations of radon and thoron and their decay products: Jour. Geophys. Research, v. 71, no. 14, p. 3357–3367, illus., 1966.

The time-dependent concentrations of natural radon, thoron, and their decay products in the atmosphere are calculated as a step toward the determination of atmospheric motion from departures from equilibrium.—D.B.V.

6885 **Stearn, Colin W.** The microstructure of stromatoporoids: Palaeontology, v. 9, pt. 1, p. 74–124, illus., 1966.

Origins of 14 recognized microstructures in tissues of Stromatoporoidea are interpreted in an attempt to provide a basis for taxonomic classification, although no new classification is presented. Primary microstructures, believed to have been secreted by the organism, are: compact, cellular and microreticulate vacuolate, ordinicellular striated, tubulate, peripherally vesicular. Secondary microstructures, produced during preservation, are: water jet fibrous, flocculent, pseudolobular, melanospheric. Fibrous, tripartite laminae, and transversely porous tissues are both primary and secondary. Microstructures of 22 common genera of Stromatoporidae and related families, and of 10 genera of Labechiidae, are reviewed, and emended diagnoses of genera are provided. Species illustrated are of early Paleozoic age; most are from the Devonian of North America.—V.M.J.

Stearns, R. G. *See* Ferguson, C. C. 6984

7069 **Steinbrugge, Karl V.** Parkfield earthquakes of June 27–29, 1966, Monterey and San Luis Obispo Counties, California—Preliminary report, structural damage: Seismol. Soc. America Bull., v. 56, no. 4, p. 971, 1966.

Very little building damage occurred in the Parkfield earthquakes. This is due in part to the wood frame construction generally found in the heaviest-shaken areas. A few headstones overturned in cemeteries, and there was minor damage to bridges.—D.B.V.

6823 **Steineck, P. L.** *Gavellinella olssoni*, new name for the foraminiferal species *Cibicides compressus* Olsson, 1960: Jour. Paleontology, v. 40, no. 5, p. 1248, 1966.

The name *Cibicides compressus* was preoccupied when Olsson assigned this name to a new species. In this paper the species is given a new specific name and is assigned to the genus *Gavellinella*.—J.F.M.

7053 **Stellmack, John A.** An alpine karst in the United States [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 94, 1966.

6718 **Stewart, Gordon L.** Experiences using tritium in scientific hydrology, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 643–658, illus., tables [1966?].

The U.S. Geological Survey monitors tritium in precipitation and in surface waters at several locations within the United States and Puerto Rico. Data on geographical and seasonal variations during 1963 and 1964 used to correlate tritium activity with hydrologic characteristics used in research are presented. Investigations are being conducted to determine the potential capabilities of tritium tracer and age dating techniques. Tritium fractionation occurs during the diffusion of water through clays. Laboratory results indicate tritium is exchanged with hydrogen in the clay mineral structure.—*from* Author's abstract

7109 **Stewart, John H.** Correlation of Lower Cambrian and some Precambrian strata in the southern Great Basin, California and Nevada, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C66-C72, illus., 1966.

Lower Cambrian and some Precambrian strata of the Spring Mountains–Death Valley region of Nevada and California correlate with rocks of the White–Inyo Mountains region of California. The equivalent strata generally increase in thickness, are more calcareous, and become finer grained northwestward from the Spring Mountains–Death Valley facies to the White–Inyo Mountains facies. The Reed Dolomite, formerly correlated with the Noonday Dolomite, is here correlated with dolomite layers in the upper part of the Stirling Quartzite.—Author's abstract

Stipp, J. J. *See* Noakes, John E. 6753

6986 **Stipp, J. J.; Knauer, G. A.; Goodell, H. G.** Florida State University radiocarbon dates I: Radiocarbon, v. 8, p. 46–53, 1966.

Dating at the Florida laboratory has been in progress since February 1965. Carbon-14 dating results are presented for geologic samples from Florida and Antarctica, and archeological samples from Florida and Alabama.—M.C.M.

Stöber, Werner. *See* Bohn, Ernst. 7131

Strange, W. E. *See* Woollard, G. P. 7215

Strens, R. G. J. *See* Evans, B. W. 7047

6840 **Strimple, Harrell L.** A unique crinoid from the Upper Permian: Oklahoma Geology Notes, v. 26, no. 3, p. 80–84, illus., 1966.

A new family, Indocrinidae (suborder Poteriocrinitina), and a new genus, *Metaindocrinus*, are diagnosed; the type species, *M. cooperi*, n. sp., is described, with holotype figured, from the upper Word Formation, near Hess Canyon, Glass Mountains, Texas. The family Indocrinidae is distinguished by suppressed development of arms, infrabasals reduced to three, and pore slits at angles of the cup plates; it also includes the less primitive Permian genera *Indocrinus* Wanner, 1916, from Timor, Indonesia, and *Proindocrinus* Yakovlev, 1939, from Ural Mountains, USSR. Possible relationships with Ordovician Palaeocrinidae and with other genera are discussed.—V.M.J.

6933 **Strimple, Harrell L.** Some notes concerning the Allagecrinidae: Oklahoma Geology Notes, v. 26, no. 4, p. 99–111, illus., 1966.

Phylogenetic relations of late Paleozoic allagecrinid Crinoidea of North America and elsewhere are diagrammed, and evolutionary trends discussed. *Allagecrinus* Carpenter and Etheridge, 1881, is restricted to Devonian and Mississippian species; Pennsylvanian species assigned to *Isoallagecrinus*, n. gen., and Permian species to *Metallagecrinus*, n. gen. *Isoallagecrinus eaglei*, n. sp., is described from Lower Permian of Osage County, Okla. *Kallimorphocrinus*, *Desmacriocrinus*, n. gen., type species *K. weldenensis*, Mississippian, lacks clear affinity with other allagecrinids.—V.M.J.

6734 **Stuckenrath, R., Jr.** Carbon-14 and the unwary archeologist, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 304–317, illus. [1966?].

The necessity for a program to educate archeologists in the proper use of radiocarbon dates is discussed and illustrated by various examples of misinterpretation of dates because of lack of understanding of the source or contamination of the sample. It is proposed that a handbook be prepared for use of archeologists.—V.S.N.

7015 **Stuckenrath, Robert, Jr.; Coe, William R.; Ralph, Elizabeth K.** University of Pennsylvania radiocarbon dates IX: Radiocarbon, v. 8, p. 349–385, illus., 1966.

Radiocarbon dates completed as of November 1965 are listed for archeologic samples from shipwrecks in the Mediterranean Sea, and from Iran, Turkey, Nova Scotia, Newfoundland, Labrador, Quebec, Northwest Territories, Alaska, Kodiak Island, Peru, Venezuela, British Honduras, and Guatemala.—M.C.M.

6974 **Stueber, Alan M.; Murthy, V. Rama.** Potassium:rubidium ratio in ultramafic rocks—Differentiation history of the upper mantle: Science, v. 152, no. 3737, p. 740–741, illus., tables, 1966.

The increase in K/Rb ratio with decrease in potassium content found in basaltic rocks does not seem to apply to ultramafic rocks. The ratios in a series of alpine ultramafic rocks and ultramafic inclusions in basalts and kimberlite pipes are about 200 to 500—significantly lower than those in oceanic tholeiites. This characteristic of ultramafic rocks appears to be consistent with a simplified model in which early differentiation of the primitive mantle led to formation of an upper mantle region enriched in alkali elements and having a low K/Rb ratio. Alpine ultramafic rocks may be residuals from such an upper mantle region.—J.J.C.

7010 **Stuiver, Minze; Suess, Hans E.** On the relationship between radiocarbon dates and true sample ages: Radiocarbon, v. 8, p. 534–540, illus., table, 1966.

A summary is given of current knowledge pertaining to differences between radiocarbon ages and true ages and of the status of empirical calibration of the radiocarbon time scale. Recent measurements have shown that a more complicated relation exists between radiocarbon age and exact calendar age of samples than was assumed by Libby; the relation can be derived empirically by determination of radiocarbon contents of samples of known age. Causes for fluctuations of the C-14 activity of atmospheric CO_2 are reviewed briefly. Work of tree-ring laboratories should make available precisely dated samples many thousand years old for use as an empirical correction table relating radiocarbon ages to true ages of the sample; radiocarbon and true ages for the last 2,000 years are tabulated. Only one C-14 age exists for each calendar year but a radiocarbon age may correspond to more than one true age.—V.S.N.

Suess, Hans E. *See* Stuiver, Minze. 7010

Sutton, George H. *See* Talwani, Manik. 6714

6926 **Swain, F. M.; Rogers, M. A.** Stratigraphic distribution of carbohydrate residues in Middle Devonian Onondaga beds of Pennsylvania and western New York: Geochim. et Cosmochim. Acta, v. 30, no. 5, p. 497–509, illus., tables, 1966.

Average total carbohydrate content of limestones, shales, and cherts of the Onondaga Group is about 50 ppm, but there are significant variations which could be due to differences in source material and conditions of deposition. Areas of high concentration may have received excessive contribution of organic matter from the land, or from floating vegetation; an area of low concentration may have been a shelf where scavenger activity was high. Average total carbohydrate content of 16 dark shales from Devon, England, is about 30 ppm. A range of 25–50 ppm appears to be normal; significant departures indicate unusual conditions of deposition or post-depositional effects.—D.B.V.

Swanson, Vernon E. *See* Palacas, James G. 7112

7196 **Swanson, Vernon E.; Frost, Irving C.; Rader, Lewis F., Jr.; Huffman, Claude, Jr.** Metal sorption by northwest Florida humate, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C174-C177, illus., tables, 1966.

Experiments with both natural and chemically extracted humate indicate that this water-soluble organic material from Florida can sorb between 1 and 17 percent by dry weight of cobalt, copper, iron, lead, manganese, molybdenum, nickel, silver, vanadium, and zinc. The enrichment of metals in ancient carbonaceous sedimentary rocks may be due in part to humate that acted as a scavenger or sponge for metals during exposure to metal-bearing natural water before, during, or shortly after deposition. Because of its metalsorptive properties, large tonnages, and thin, easily removed overburden of loose sand, the Florida humate may find use in the chemical and fertilizer industries.—Authors' abstract

Switzer, George. *See* Melson, William G. 6822

7220 **Szabo, Bela.** The status of the world gravity standardization and first-order net, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 12-22, illus., 1966.

Progress of the work for establishment of a uniform world gravity system, initiated at the 4th assembly of the International Gravity Commission, Paris, 1962 is described and illustrated on maps. Measurements performed since 1963 consist of observations by selected pendulums and groups of gravimeters along three primary calibration lines (Euro-African, American, and West Pacific) and of transverse pendulum and gravimeter connections between these lines. Completed observations are described and a tentative schedule indicated for additional observations. The status of several portable absolute experiments that would contribute to the program for establishment of a new international absolute reference system is described.—*from* Author's abstract

Taggart, James. *See* Herrin, Eugene. 6712

Takéuchi, Y. *See* Wuensch, B. J. 6700

6714 **Talwani, Manik; LePichon, Xavier; Ewing, Maurice; Sutton, George H.; Worzel, J. Lamar.** Comments on paper by W. Jason Morgan, "Gravity anomalies and convection currents—[Pt.] 2, The Puerto Rico Trench and the Mid-Atlantic Rise" [1965]: Jour. Geophys. Research, v. 71, no. 14, p. 3602-3606, 1966.

Morgan's hypothesis (ibid., v. 70, no. 24, p. 6189-6204, 1965) fails to account for the structure of the Mid-Atlantic Ridge and Puerto Rico Trench on three major counts: Some of his theoretical bases are controversial and inconsistent; his derived structures conflict with refraction data for regions under trenches and are based on an unexplained and artificial distinction between shallow and deep compensation under ridges; and his density model is not consistent with the temperature model which results from the convection currents he assumes in the crust and mantle, and surface heat flow values predicted from his model conflict with measured values.—D.B.V.

7214 **Talwani, Manik.** Some recent developments in gravity measurements aboard surface ships, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 31-47, illus., 1966.

Errors by surface ship gravimeters from the ship's horizontal accelerations are discussed. Results from a continuously recording analog computer show that cross-coupling errors can be appreciable. Off-leveling errors for the Anschutz gyrotable aboard R. V. *Robert D. Conrad* are small. It is shown that off-leveling error in determination of the Browne correction for a gimbal-suspended gravimeter is identical to off-leveling error by a gravimeter on a stable platform, provided the same vertical reference is used and servo errors are the same. Gyros are more error free as vertical references than long-period pendulums. A simple slope correction can be applied to the record of Graf-Askania Gss2 gravimeter to correct

for instrument response. An analog computer to compute and record Eotvos correction continuously has been developed. Data reduction and display procedures are described.—*from* Author's abstract

7011 **Tamers, M. A.** Instituto Venezolano de Investigaciones Científicas natural radiocarbon measurements II: Radiocarbon, v. 8, p. 204–212, 1966.

Radiocarbon dates measured from December 1964 to November 1965 include ground-water samples from Venezuela, and archeologic samples from Venezuela, Jamaica, Chile, Colombia, Argentina, Peru, Alaska, and Texas.—M.C.M.

Tamers, M. A. *See* Pearson, F. J., Jr. 7017

6898 **Tamers, Murry A.** Routine carbon-14 dating using liquid scintillation techniques, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 53–67, illus., table [1966?].

At the beginning of liquid scintillation counting, it was suggested that it could be used for radiocarbon dating. Starting in 1959, attention turned to synthesized benzene as the scintillation solvent. The steps involved in this synthesis are described. The counting method is discussed in detail, and possible errors from isotope effect, radon contamination, and quenching are found to be unimportant. Counter reproducibility is discussed and the performances and advantages of some liquid scintillation counters listed in tables.—E.S.L.

6646 **Taney, Norman E.; Allen, Richard H.** (compiler; editor). Interagency conference on continental shelf research: U.S. Army Corps Engineers Coastal Eng. Research Center Misc. Paper 1–66, 37 p., 1966.

Because of the widespread interest in the morphology and sediments of the Continental Shelf, this meeting provided a forum at which the various governmental agencies could describe their programs and learn about the programs of other agencies. Thus, key personnel would become knowledgeable on the entire Federal research effort on the Continental Shelf, and in instances involving similar objectives or collection efforts, might initiate cooperative programs. This pamphlet contains abstracts and summaries of the proceedings.—G.D.C.

7039 **Tanner, R. W.** Astronomical evidence on the present rate of continental drift, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 71–74, 1966.

There is almost as much argument over interpretation of astronomical observations for relative motion of continents over the last 50 years as there is over continental drift itself. Considering difficulties in measurement, more specialized instruments are necessary. The International Latitude Service has had a chain of five zenith telescopes around the world in lat 39°08′ N. in operation since the end of the last century. A minutely detailed path of polar motion is revealed, but observed latitudes can be accounted for by polar motion plus errors in observation. The largest residual from the polar motion solution is only 0.024″; secular motions appear to be less than one cm per year. Artificial satellites offer possibilities, but the dynamics of satellite motion must be dealt with, as well as limitations of time and weather. Evidence on longitudinal changes is much less satisfactory.—G.D.C.

6934 **Tatsumoto, M.** Genetic relations of oceanic basalts as indicated by lead isotopes: Science, v. 153, no. 3740, p. 1094–1101, illus., tables, 1966.

It is concluded that (i) the isotopic composition of lead in oceanic tholeiite suggests that the upper mantle source region of the tholeiite was differentiated from an original mantle material more than 1 billion years ago and that the upper mantle is not homogeneous at the present time, (ii) less than 20 million years was required for the crystal differentiation within the alkali suite from Easter Island, (iii) no crustal contamination was involved in the course of differentiation of rocks from Easter Island; however, some crustal contamination may have affected Guadalupe Island rocks, and (iv) alkali basalt may be produced from the tholeiite in the oceanic region by crystal differentiation.—Author's abstract

7012 **Tauber, Henrik.** Copenhagen radiocarbon dates VII: Radiocarbon, v. 8, p. 213–234, 1966.

Radiocarbon dates compiled to November 1965 are listed from geologic and pollen-dated samples from Denmark and England; and archeologic samples from Denmark, Greenland, Iceland, Poland, and Qatar.—M.C.M.

6653 **Taylor, Hugh P., Jr.; Noble, James A.** Origin of magnetite in the zoned ultramafic complexes of southeastern Alaska [abs.]: Econ. Geology, v. 61, no. 4, p. 798–799, 1966.

7023 **Teleki, P. G.** Fluorescent sand tracers: Jour. Sed. Petrology, v. 36, no. 2, p. 468–485, illus., 1966.

Sediment migration may be studied with the aid of fluorescent organic substances applied in a colloidal state to sand particles along with a binding material. The substances are excited by 3650 or 2537 A wave length ultraviolet light. Tracer material simulates the physical characteristics of the body of sediment in which it is dispersed. Tracer grains, except for their fluorescent properties are indistinguishable from untreated grains. The most useful fluorescent dyes belong in the class xanthenes. Binding materials are found in adhesive amino and acrylic resins. Tracers are available in a wide variety with regard to color and duration.—R.A.C.

6674 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Texarkana sheet—Elias H. Sellards Memorial Edition: Austin, Tex., Univ. Texas Bur. Econ. Geology, scale 1:250,000, 1966.

6807 **Textoris, Daniel A.; Carozzi, Albert V.** Petrography of a Cayugan (Silurian) stromatolite mound and associated facies, Ohio: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1375–1388, illus., tables, 1966.

Petrographic study has shown eight major microfacies which constitute an algal stromatolite mound and associated rocks in the Greenfield Dolomite near Maumee, Ohio. These microfacies form five major depositional units indicative of depositional environments ranging from high intertidal or supratidal to shallow subtidal, and related to generally quiet, restricted, and penesaline conditions. The mound, which forms the base of the stratigraphic section, is composed of stromatolite-constructed dolomite and is overlain by stromatolitic dolobreccia, flat stromatolite-constructed dolomite, pelletoidal dolarenite, and evaporitic dolosiltite. These facies are compared with Recent carbonate units which suggest that they formed under transgressive conditions.—E.K.M.

6651 **Thayer, T. P.** Gravity differentiation and magmatic replacement of podiform chromite deposits [abs.]: Econ. Geology, v. 61, no. 4, p. 796, 1966.

6994 **Thayer, T. P.** Serpentinization considered as a constant-volume metasomatic process: Am. Mineralogist, v. 51, nos. 5–6, p. 685–710, illus., tables, 1966.

The three classic arguments for major expansion of peridotite during serpentinization—(1) constant composition except for hydration, (2) internal deformation, and (3) lack of Mg- or Si-metasomatism in country rocks—are considered and found invalid in specific instances, and probably in general. . . . Failure to recognize the chemical changes accompanying serpentinization has led to serious exaggeration of the original pyroxene content of alpine peridotite.—Author's abstract

7110 **Thayer, T. P.; Brown, C. Ervin.** Local thickening of basalts and Late Tertiary silicic volcanism in the Canyon City quadrangle, northeastern Oregon, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C73–C78, illus., 1966.

Thickening of basalts of the Columbia River Group to 6,000 feet along the Monument swarm of feeder dikes implies that the overlying Mascall Formation probably was at least 6,000–7,000 feet thick at Picture Gorge. Over much of the

present Canyon City quadrangle the Columbia River Group and stratigraphically equivalent Strawberry Volcanics probably attained a thickness of 8,000 feet or more in early Pliocene time. The nature of the Mascall Formation reflects the former existence of a thick regional cover of silicic volcanic rocks, only relatively thin remnants of which are preserved in isolated structural basins.—Authors' abstrak

Thomas, D. M. *See* Benson, M. A. 6962

7223 **Thompson, Lloyd G. D.; Hawkins, Charles S.** Advances in aerial gravity 1963-1964, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 28-30, illus., 1966.

Continuing research at AFCRL (Air Force Cambridge Research Laboratories) during 1963 and 1964 produced a C-130 and KC-135 aircraft modified and instrumented for aerial gravity measurements, a new stabilized platform for airborne gravimeters, a new configuration of the LaCoste-Romberg gravimeter on the new stabilized platform with new transistorized electronics, a new revision of the Askania-Graf gravimeter on a stabilized platform with new transistorized electronics, a digital magnetic tape recording system for both of the above meters and for the Air Profile Recorder, and a new Worden miniature digital airborne gravimeter.—Authors' abstract

Threadgold, Ian M. *See* Ryall, William R. 6998

6909 **Thurber, David L.; Broecker, W. S.; Kaufman, A.** The comparison of radiocarbon ages of carbonates with uranium series ages, *in* Internat. Conf. Radiocarbon and Tritium Dating, 6th, 1965, Proc.: U.S. Atomic Energy Comm. Rept. CONF-650652, p. 367-382, illus., tables [1966?].

Uncertainties in the initial C-14/C-12 ratio and the possibility of post-depositional contamination are serious problems in assignment of radiocarbon ages to carbonates. Independent age determinations of fossils based on the growth of Th-230 from an initial deficiency toward equilibrium with its parent U-234 confirms the general validity of the assumptions used in calculating radiocarbon ages in the 3-25 thousand year range. A Th-230/U-234 age far older than that obtained by radiocarbon suggests that the finite radiocarbon age has resulted from contamination by more recent carbon. Careful measurements on coral ranging from 4,000 to 20,000 years old may be useful in studying secular variations in C-14/C-12 in the surface ocean during this period of time.—Authors' abstract

6769 **Thurber, David Lawerence.** Natural variation in the ratio U^{234}/U^{238} investigation of the potential of U^{234} for Pleistocene chronology [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7261-7262, 1966.

6664 **Tieh, Thomas Ta-pin.** Heavy mineral assemblages in some Tertiary sediments near Stanford University, California [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7353, 1966.

Ting, William S. *See* Berger, Rainer. 6901

6832 **Toewe, E. Clayton; LeVan, D. C.** Anomalous magnetization in Triassic diabase near Leesburg, Loudoun County, Virginia: Geophysics, v. 31, no. 3, p. 618-621, illus., 1966.

A roughly circular, 3,000-γ closed negative magnetic anomaly about 15 feet in diameter near Leesburg, Va., is described; it is attributed to lightning.—D.B.V.

Tooker, E. W. *See* Moore, William J. 7083

7026 **Tóth, J.** Mapping and interpretation of field phenomena for groundwater reconnaissance in a prairie environment, Alberta, Canada: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 2, p. 20-68, illus., tables, 1966.

In regions where surface water does not obscure the phenomena produced by ground water, areas of downward flow and upward flow can be differentiated by mapping. In a section of the Ghostpine Creek valley on the Alberta Plains, the relief is gently rolling, the geology simple, and the climate cold, humid, and continental. The area of "north-flow-systems" is apportioned: 26 percent underlain by downward flow, 42 percent by a mid-line area, and 32 percent by upward flow. Noting that ground water flow is nearly parallel to the water table near the mid-line these results comply with the above theory of distribution in small drainage basins. The method is suggested for reconnaissance of the ground water regime in certain areas; and for specific problems in a Prairie environment, such as sites for dug-out water supplies, slough-draining and irrigation, and development of certain soil types.—G.D.C.

6888 **Toulmin, Priestley, 3d.** Retrograde melting in the system Mg-Fe-Si-O [discussion of paper by D. H. Speidel and R. H. Nafziger, 1966]: Science, v. 153, no. 3744, p. 1674, 1966.

When certain necessary corrections are made to the figures in the paper by Speidel and Nafziger (ibid., v. 152, p. 1367, 1966), it becomes evident that the possibilities for "retrograde melting" are in fact significantly greater than they recognized. It is also argued that the slopes of lines on diagrams of log f versus 1/T cannot be interpreted in terms of physical heat; comparison with standard enthalpy of wustite provides at best only a crude qualitative indication of the energy balance in the process under consideration.—D.B.V.

Toulmin, Priestley, 3d. *See* Barton, Paul B., Jr. 7183

6992 **Trautman, Milton A.; Willis, Eric H.** Isotopes, Inc. radiocarbon measurements V: Radiocarbon, v. 8, p. 161-203, 1966.

Radiocarbon dates compiled during years 1963 to 1965 and measurements made previously for which sample data had not been published are listed on geologic samples from Alaska, United States, Canada, Greenland, Finland, Northern Ireland, Africa, and Brazil; physical geography samples from Northwest Territories and other provinces of Canada; archeologic samples from United States, Sudan, Italy, French Polynesia, and Peru; and miscellaneous samples from southeastern United States.—M.C.M.

7096 **Trembly, Lynn D.; Berg, Joseph W., Jr.** Amplitudes and energies of primary seismic waves near the Hardhat, Haymaker, and Shoal nuclear explosions: Seismol. Soc. America Bull., v. 56, no. 3, p. 643-653, illus., tables, 1966.

Records of near-source (0.3-20 km) primary seismic waves generated by the Hardhat, Haymaker, and Shoal underground nuclear shots were analyzed in terms of displacement amplitudes and energy variations with distance. The observed data were compared with those for a theoretical source model. As predicted theoretically, there was evidence of a long-period displacement field near the explosion. The variation of total energy of the observed primary waves with distance showed the presence of the long-period field. The theoretical elastic source model apparently approximates the observed sources.—D.B.V.

7037 **Trojer, Felix J.** Refinement of the structure of sulvanite: Am. Mineralogist, v. 51, nos. 5-6, p. 890-894, illus., tables, 1966.

The structure of sulvanite, Cu_3VS_4, was solved by Pauling and Hultgren (1933). The bonding of vanadium to sulfur is an unusual one which, it was thought, warranted checking and refining the structure. The crystals have symmetry $P\bar{4}3m$, with $a = 5.3912 \pm 0.0007$A. Pauling and Hultgren's structure was confirmed and refined by least squares. The new value of the positional parameter of sulfur . . . leads to a vanadium-sulfur distance of 2.214A and a copper-sulfur distance of 2.297A.—Author's abstract

Tunell, George. *See* Weissberg, B. G. 6862

6978 **Turekian, Karl K.; Bolter, Ernst.** Calcium, *in* Treatise on analytical chemistry—Pt. 2, Analytical chemistry of inorganic and organic compounds, V. 4, Sec. A: New York, Interscience Publishers, p. 107–152, tables, 1966.

The abundance of calcium in various materials of the Earth's crust is summarized, in comparison with strontium and barium; its mineral compounds are listed; and isotopic and atomic properties are described. Separation techniques by precipitation and by ion exchange are reviewed, various determination methods are described briefly, and suggested analytical schemes are given.—G.D.C.

7021 **Turekian, Karl K.; Bolter, Ernst.** Strontium and barium, *in* Treatise on analytical chemistry—Pt. 2, Analytical chemistry of inorganic and organic compounds, V. 4, Sec. A: New York, Interscience Publishers, p. 153–217, tables, 1966.

The abundance of strontium and barium in materials of the Earth's crust are summarized, their minerals and radioactive isotopes are listed, and atomic properties are described briefly. Analytical procedures are reviewed for various methods of separation and determination of strontium and barium as major components and in trace amounts. Suggested analytical schemes are mentioned for a number of different situations.—G.D.C.

Turner, Grenville. *See* Merrihue, Craig. 6722

7086 **Turner, William M.** An improved method for recovery of bromoform used in mineral separations, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C224–C227, illus., tables, 1966.

A continuous flow of fresh water circulates through a recovery bottle of simple design to separate solvent from bromoform-rich washings. Two groups of experiments show that the process may increase the recovery of bromoform, as compared with recovery by conventional methods, and that it obtains the same degree of purity. In addition, this new method eliminates the manual operations involved in the conventional methods. The method has also been found to be suitable for the recovery of methylene iodide.—Author's abstract

Tuttle, O. F. *See* Scarfe, C. M. 6996

Tuttle, O. F. *See* Peters, Tj. 6997

6650 **Ulmer, Gene C.** Experimental investigations in chromite spinels [abs.]: Econ. Geology, v. 61, no. 4, p. 795–796, 1966.

6818 **Ulrych, T. J.; Reynolds, P. H.** Whole-rock and mineral leads from the Llano Uplift, Texas: Jour. Geophys. Research, v. 71, no. 12, p. 3089–3094, illus., table, 1966.

The development of lead isotope ratios in whole-rock systems may be considered to have taken place in two environments: (1) the common lead environment, before the formation of the whole rock system, and (2) the radiogenic lead environment, after its formation. Zartman's lead data from the Llano Uplift [1965] have been used in independent studies of the two terminations. The common leads which are interpreted by well-established techniques also yield numerical results that agree with the Rb/Sr values. Both approaches exhibit a two-stage history analogous to Rb/Sr results.—Authors' abstract

7194 **Uotila, U. A.** (reporter). Existing surface gravity material, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 3–11, illus., 1966.

World gravity coverage data compiled at the Department of Geodetic Science at Ohio State University, Columbus, between the symposium meetings of 1961 and 1964 are summarized. If each $1° \times 1°$ block with at least one observation is taken as an area having gravity coverage, the data indicate an increase in area coverage of 13 percent in the Northern Hemisphere, 19 percent in the Southern Hemisphere, and 14 percent for the whole world. Total coverage for the entire Earth to date

is about 35 percent, the largest gap being in the southern Pacific Ocean. Steps to be taken between collection, reduction, and production of mean anomaly maps are reviewed. Additional information received at the symposium is listed.—V.S.N.

7089 **Upson, Joseph E.** Relationships of fresh and salty ground water in the northern Atlantic coastal plain of the United States, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C235–C243, illus., 1966.

Mapping of the boundaries between fresh and salty water in selected aquifers in the northern Atlantic coastal plain of the United States reveals that the limit of salty water and the configuration of the present coastline correspond closely only in the late Pleistocene and Recent deposits. In successively older aquifers the correspondence is progressively less. Here the salt-water boundaries are believed to be controlled chiefly by the circulation patterns of the fresh water in the aquifers, notably the locations of discharge zones. Also, in Maryland and Delaware large lenses of fresh water that might represent Oligocene and Pliocene episodes of terrestrial conditions are lacking. Thus, hydrodynamic adjustment of the boundaries has been rapid enough to keep pace with the general relative changes of sea level since Cretaceous and Eocene times.—Author's abstract

6931 **Urban, L. L.** *Cappasporites*, a new Pennsylvanian spore genus from the Des Moines Series of Oklahoma: Oklahoma Geology Notes, v. 26, no. 4, p. 111–114, illus., 1966.

Cappasporites distortus, n. gen., n. sp., a radial trilete spore similar to *Crassispora*, is described from the Bluejacket coal of the Boggy Formation at Inola Mound, Rogers County, Okla. (holotype), and from the same horizon near Vinita in Craig County. The abundant and easily recognized spore may be restricted to the Boggy Formation, as no similar spores have been reported from the underlying Drywood coal (Savanna Formation) nor from overlying Senora Formation. *Cappasporites* is found associated with *Lycospora, Laevigatosporites, Endosporites*, and others, and attains a maximum of 26 percent of the assemblage at Inola Mound.—V.M.J.

6670 **U.S. Geological Survey; California Div. Mines and Geology.** (compilers). Geologic map of California: U.S. Geol. Survey Misc. Geol. Inv. Map I–512, scale 1:2,500,000, 1966.

7139 **Valentine, James W.** The present is the key to the past: Jour. Geol. Education, v. 14, no. 2, p. 59–60, 1966.

The doctrine of uniformitarianism has been vigorously disputed in recent years, as to its meaningless and erroneous components. The present article is directed primarily towards classroom presentation of the doctrine, especially as epitomized in the maxim given in the title, emphasizing the limitations that invalidate the view of the geologic past that is harbored in the semantics of the "key" maxim. The external environment is never really the same. The operation of a process alters the configuration, and subsequent operation must necessarily occur in a new configurational context. It would be more realistic to utilize modern insight into both the valid and invalid aspects of the uniformitarian doctrine in order to illuminate the nature of historical science.—G.D.C.

VanSickle, G. H. *See* Erickson, R. L. 6896

7070 **vanSteenburgh, W. E.; Giroux, Mary J.** Scientific research in the Arctic—Canada: Arctic, v. 19, no. 1, p. 48–61, illus., 1966.

Current geophysical and geological studies in the Canadian Arctic have revealed a number of metallic mineral and asbestos resources, and an estimated one million cu mi of oil- and gas-bearing sedimentary rocks which could amount to 13 billion bbl of oil beneath permafrost in Northwest Territories, 3 billion bbl in Yukon, and 33 billion bbl in the Arctic Islands. Two unusual anomalies have come to light, and paleomagnetism on Ellef Ringnes Island has disclosed a different pole position in Mesozoic time. The largest program, the cooperative Polar Continental Shelf Project in the archipelago region, includes aeromagnetic surveys, sedimentation studies, and age determinations. Seismologists have found crustal thinning under

the shelf, possible restricted sedimentary basins separate from Sverdrup Basin, and properties in deeply buried formations of the Franklinian geosyncline similar to exposures farther northeast.—G.D.C.

Vargo, J. L. *See* Philbin, P. W. 6697

Vargo, J. L. *See* Philbin, P. W. 6698

6877 **Veatch, J. O.; Humphrys, C. R.** Water and water use terminology: Kaukauna, Wis., Thomas Printing and Publishing Co., 375 p., illus., 1966.

This manual includes geologic, economic, geomorphologic, hydrologic, hydrographic, limnologic, ecologic and engineering terms, and some of a legal nature as well as terms pertaining to use, management and conservation, and a large number of colloquial terms, localisms and rare or infrequent hydronyms. It is intended to be a reference for the use of those who are interested particularly in lakes and ponds.—G.D.C.

6988 **Velde, B.** Upper stability of muscovite: Am. Mineralogist, v. 51, nos. 5-6, p. 924-929, illus., tables, 1966.

The maximum stability curve of muscovite in the presence of water pressures of 1 to 8,000 bars is revised to slightly lower temperatures.—E.H.R.

7174 **Vernon, Robert O.** Ground water hydrology and geology and their relationships to pit mining in Florida [abs.]: Mining Eng., v. 18, no. 8, p. 40, 1966.

Verschure, R. H. *See* Priem, H. N. A. 7204

7058 **Vlaar, M. J.** The field from an SH-point source in a continuously layered inhomogeneous medium—[Pt.] 1, The field in a layer of finite depth: Seismol. Soc. America Bull., v. 56, no. 3, p. 715-724, 1966.

Expressions are derived for the field from an SH-point source in a stratified heterogeneous layer of finite depth. It is found that, for a periodic disturbance, the contribution to the far field is mainly due to at most a finite number of unattenuated normal Love modes. The transient response of the medium is obtained by a Fourier synthesis. The final expressions are of a simple form, involving the eigenfunctions of a Sturm-Liouville boundary value problem. The excitation of a certain mode is a function of frequency and source depth if formulated in a concise form.—Author's abstract

Vogel, J. C. *See* Dreimanis, Aleksis. 6720

7210 **Walker, F. E.; Hartner, F. E.** Forms of sulfur in U.S. coals: U.S. Bur. Mines Inf. Circ. 8301, 51 p., table, 1966.

The total sulfur and the form of the sulfur—organic, pyritic, and sulfate—were determined in about 2,900 samples of coal from 30 states. Most of the exploited coal beds in the United States are represented. Data are tabulated for each sample, and the methods of analysis are described.—E.R.L.

6816 **Walsh, J. B.; Decker, E. R.** Effect of pressure and saturating fluid on the thermal conductivity of compact rock: Jour. Geophys. Research, v. 71, no. 12, p. 3053-3061, illus., 1966.

Regional differences in heat flow of about 15 percent are often considered to be significant. It is shown here that the observed thermal conductivity of dry samples may differ by more than 15 percent from that of the same rocks in place, saturated and under hydrostatic pressure. This is because cracks form effective heat flow barriers in dry rocks but are negligible when the rock is saturated or when the cracks are closed by stress. Formulas are presented for estimating possible error for low-porosity crystalline rocks. The theoretical expressions agree reasonably well with measurements made on dry and saturated samples of granite under axial compression up to 930 bars.—D.B.V.

6903 **Wang, Chi-Yuen.** Velocity of compressional waves in limestones, marbles, and a single crystal of calcite to 20 kilobars: Jour. Geophys. Research, v. 71, no. 14, p. 3543–3547, illus., tables, 1966.

Velocity of compressional waves in Solenhofen limestone, Oak Hill Quarry limestone, Danby marble, Rutland white marble and a single crystal of calcite (along the *c*-axis) are measured under hydrostatic condition to 20 kb. All measurements show the following characteristics: The velocity rises with increasing pressure to a maximum, falls to a minimum at 15.5±0.5 kb, and rises again with pressure. The measurements are reproducible during the course of lowering the pressure. The peculiar change of velocity at about 15.5 kb is associated with one of the calcite transitions discovered by Bridgman.—Author's abstract

Ward, P. E. *See* McClymonds, N. E. 7088

7087 **Waring, Claude L.; Conklin, Nancy.** Quantitative spectrochemical determination of minor elements in apatite, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C228–C230, tables, 1966.

A quantitative spectrochemical method for determination of 29 minor elements in apatite is described in which an apatite sample, with germanium dioxide added as an internal standard and as an excitation buffer, is mixed with graphite and consumed in a d-c arc. The spectrum is recorded, densitometric determinations are made, and the concentrations of elements are obtained from working curves. Precision is excellent for most of the elements. The data show good agreement with chemical and spectrographic determinations made in other U.S. Geological Survey laboratories.—Authors' abstract

6703 **Warren, David H.; Healy, J. H.; Jackson, Wayne H.** Crustal seismic measurements in southern Mississippi: Jour. Geophys. Research, v. 71, no. 14, p. 3437–3456, illus., tables, 1966.

A refraction survey along a 400-km line indicates complex crustal structure below the Lower Cretaceous. There is a basement trough between the Tatum dome and Raleigh, and a broad high cresting south of McNeill. An intermediate layer (6.9 kmps) rises from 19 km at McNeill to 13 km near Raleigh. Average upper mantle velocity is 8.4±0.3 kmps, average crustal thickness is 35 km, and the M-discontinuity dips 3° southward from Raleigh to Ansley. Isostatic equilibrium requires increasing density in the upper mantle below southern Mississippi, which may explain the formation of the Gulf Coast geosyncline.—D.B.V.

6837 **Wasserburg, G. J.** Geochronology, and isotopic data bearing on development of the continental crust, *in* Advances in Earth science—Internat. Conf., Massachusetts Inst. Technology, 1964: Cambridge, Mass., M.I.T. Press, p. 431–459, illus., 1966.

By contrast with oceanic crust, where it is surmised some new material is derived from a depth associated with the upper mantle, the continental crust is known to be of great complexity; exposures as old as 2,700 m.y. may represent a complicated, hybrid history. Examples of isotope studies made in both types of regions are given, to indicate what additional knowledge they have contributed. Isotopic ages have confirmed some of the better-defined structural provinces; they have also upset classifications in Precambrian terranes. The Canadian Grenville province is one example; its eastward extent and attempted correlations in the Appalachian belt and western areas of the United States are considered. Various methods confirm petrologic indications of two magma sources in Hawaii, and demand isotopic as well as chemical heterogeneity for significant time periods in the continental crust.—G.D.C.

Watkins, Joel S. *See* deBremaecker, J. C. 6914

7052 **Watkins, Joel S.; Godson, R. H.; Watson, Kenneth.** Seismic investigation of near-surface cavities—A preliminary report [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 94, 1966.

Watson, Kenneth. *See* Watkins, Joel S. 7052

7129 **Wedow, Helmuth; Carpenter, Robert H.; Lehr, James R.** Phosphorite in the Precambrian Ocoee Series of the East Fork manganese district, Sevier County, Tenn. [abs.]: Mining Eng., v. 18, no. 8, p. 44, 1966.

Weeks, A. D. *See* Young, E. J. 6939

Weeks, C. Francis. *See* Krueger, Harold W. 6991

6709 **Weertman, J.** Effect of a basal water layer on the dimensions of ice sheets: Jour. Glaciology, v. 6, no. 44, p. 191–207, illus., 1966.

Analyses of the effect of a basal water layer on equilibrium dimensions of an ice sheet indicate a profound effect on Antarctic and ice-age type ice sheets. When a thick water layer is present average shear stress at the bottom of an equilibrium ice sheet must be smaller than normal; this requires ice-sheet thickness to be reduced, and in the case of ice-age sheets the horizontal extent as well. No reliable estimate of the effect on Antarctic Ice Sheet or Pleistocene ice sheets could be made. It is possible that the water layer of an ice sheet can affect its size and stability through incorporation of morainal debris by freezing of melt water at the bottom surface. The fraction of the ablation area covered by such morainal material is calculated. Equations governing water flow at the bottom of a glacier or ice sheet are developed in more detail than in a previous publication (1962).—V.S.N.

6990 **Weertman, J.** The effect of a low viscosity layer on convection in the mantle: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 203, 20 p., illus., 1966.

If thermal convection occurs in the Earth's mantle, it may also occur within the Moon and Mars. Presumably radioactive heat generated per unit mass is similar in all three bodies, but surface morphology of the Earth differs markedly from that of the other two. This difference is ascribed to the effect produced on convection in the Earth's mantle by a low-viscosity or low-creep strength layer which changes the amount of "coupling" between outer crust and mantle convection. It is assumed that viscosity or creep strength is essentially zero in the low-viscosity layer. The deeper the layer within the mantle, the greater the coupling of outer crust to mantle convection and vice versa; depth of the layer is controlled by temperature and pressure profiles within the mantle.—V.S.N.

Weill, D. *See* Bottinga, Y. 7036

6777 **Weiss, Malcolm P.** X-radiography of rocks with I-125 source: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1507–1510, illus., table, 1966.

Under certain conditions of structure and mineralogy X-radiography can give a more sensitive picture of structure and compositional contrast than polished surfaces or peels. The method is applicable to areas much larger than a thin section. Source was a 60-day iodine-125 "point" source of less than 5 millicuries. Exposure data were made compatible by expressing exposures in Curie-minutes. Exposures were made by putting specimens horizontally on non-screen X-ray film, and because of low source distances used were 25 or 12.5 cm. For limestone differential transmission depends on difference in porosity or differences in local mineralogy. Porosity differences are readily revealed, but small-scale mineralogic differences are not well resolved. This method is simple, low in cost and does not require elaborate safety measures.—S.P.S.

6862 **Weissberg, B. G.; Dickson, F. W.; Tunell, George.** Solubility of orpiment (As_2S_3) in Na_2S–H_2O at 50–200°C and 100–1,500 bars, with geological applications: Geochim. et Cosmochim. Acta, v. 30, no. 8, p. 815–827, illus., table, 1966.

The solubility of orpiment in Na_2S–H_2O solutions was measured under conditions ranging from 0.55 to 3.43 weight percent Na_2S, temperatures from 25 to 200°C and pressures from 100 to 1,500 bars. Orpiment is highly soluble in Na_2S solutions. . . . Orpiment solubility increases nearly linearly with increasing Na_2S concentration,

but decreases nonlinearly with increasing pressure. Temperature change affects orpiment solubility only slightly at temperatures below about 120°C, but above 120°C increasing temperature increases the solubility at an increasing rate. Factors that would lead to deposition of orpiment in nature are decreasing temperature, reactions with wall rocks, or acidification and oxidation reactions with ground water solutions.—Authors' abstract

7176 **Welby, Charles W.** Groundwater changes adjacent to Lee Creek phosphate mine, Beaufort County, N. C. [abs.]: Mining Eng., v. 18, no. 8, p. 41, 1966.

Wensink, H. *See* Opdyke, N. D. 6815

Wentworth, C. M. *See* Campbell, R. H. 7099

Wermund, E. G. *See* Harvey, J. R. 6916

6704 **Werth, Glenn; Randolph, Philip.** The Salmon seismic experiment: Jour. Geophys. Research, v. 71, no. 14, p. 3405–3413, illus., 1966.

The Salmon nuclear detonations of October 22, 1964, had a nuclear yield of 5.3±0.5 kt; teleseismic magnitude was 4.35. P-waves observed to 2,500 km show asymmetries in propagation, with higher amplitudes, faster apparent velocities, and higher frequencies to the north and northeast than to the west. If a cavity were built of a size to fully decouple 5 kt at the Salmon site, theoretical calculations predict a decoupling factor of about 170, or magnitude of 2.1; if such a cavity were used for partially decoupling a 25-kt shot the predicted magnitude is 3.1. Drilling into the Salmon shot region revealed a standing shot cavity of 20,000 m^3, corresponding to a sphere of 17-m radius.—D.B.V.

6821 **Weyl, Peter K.** Environmental stability of the Earth's surface—Chemical consideration: Geochim. et Cosmochim. Acta, v. 30, no. 7, p. 663–679, illus., tables, 1966.

The persistence of life on Earth indicates that variations of the environmental variables have been limited within the life history. Equilibria between the sea water and solid phases are not adequate to explain this stability; feedback relations among the hydrosphere, lithosphere, and biosphere must be operating. An analysis of a simple model shows that the ocean–atmosphere interaction helps to stabilize the environment. For a more detailed analysis extending farther into the past, the functions that relate the rates of the various processes to the environmental variables must be known.—D.B.V.

6767 **Weyl, Richard.** Tektonik, Magmatismus und Krustenbau in Mittelamerika und Westindien [with English summ.]: Geotektonische Forschungen, no. 23, p. 67–109, illus., tables, 1966.

Similarity of magmatic products in the circum-Caribbean region contradicts the theory that sialic magmas are formed by fusion of roots of a sialic crust. In the volcanic–plutonic belt of northwestern Central America, all types of rocks are found in enormous extrusions started during the late Tertiary, and numerous Cretaceous or later plutonic rocks derived from the same magma; Quaternary volcanism concentrated on the Pacific marginal zone. In the southern Central American orogen the tectonic–igneous sequence started with Cretaceous basaltic and ultrabasic magmas; granitic Tertiary intrusions had no root of sialic crust. Conditions are similar in the Greater Antilles with no apparent continental crust except in Cuba; magmatic activity may be considered geosynclinal with a typical calc-alkaline Pacific series. The Lesser Antilles chain belongs to the circum-Pacific volcanic belt. G.D.C.

7068 **Weyl, Richard.** Eine Reliefkarte des Hochlandes von Guatemala and ihre geologische Interpretation: Natur u. Mus., v. 96, no. 2, p. 63–68, illus., 1966.

The geomorphic features shown on a relief map of the central Highlands of Guatemala are compared with a geologic sketch map. Striking ESE/WNW is a chain of active and Pleistocene volcanoes, of which the highest (3,960 m) is centrally

located. Tertiary volcanic rocks spread out to the north in a dissected plateau, bordered by the Sierra de Chaucús composed of late Paleozoic or Mesozoic crystalline schists and massive serpentinites. The Rio Motagua, deeply entrenched in the plateau, flows eastward in a meandering valley in the serpentinite. Southwestward below the volcanic chain is the alluvial coastal plain. Guatemala City lies in a N–S striking graben in the plateau. Fields of pumice stone cover parts of the plateau, and plutonic plugs as well as cinder cones are scattered along the volcanic chain.—G.D.C.

7161 **Weyl, Richard.** Ozeanische Krust im südlichen Mittelamerika?: Neues Jahrb. Geologie u. Paläontologie Monatsh. 1966, no. 5, p. 275–281, illus., table, 1966.

On the Pacific side of Costa Rica, submarine basic volcanites, subeffusive eruptives, and volcanogenic conglomerates associated with marine sediments are widespread. The paleogeographic situation and rock associations suggest that this is oceanic crust which has subsequently become incorporated into the continental domain.—D.B.V.

6795 **Wheeler, Harry E.** Oligocene–Miocene boundary—Discussion [of paper by P. Vella, 1965]: Geol. Soc. America Bull., v. 77, no. 4, p. 447–448, 1966.

Despite Vella's excellent treatment of the general problem of the Oligocene–Miocene boundary (ibid., v. 76, p. 349–356, 1965), his proposal falls short in his contention that no one person may attempt to fix the boundary, and in his belief that the question of priority is involved. All truly creative science is the product of individuals, and Vella and others have shown that the Oligocene–Miocene boundary has never been established, thus, no question of priority or conflict is involved. It is hoped that Vella will make a specific proposal for the boundary.—V.S.N.

Wheeler, V. *See* Rawson, D. 6724

6999 **White, William B.; Keester, Kenneth L.** Optical absorption spectra of iron in the rock-forming silicates: Am. Mineralogist, v. 51, nos. 5–6, p. 774–791, illus., tables, 1966.

Optical absorption spectra have been obtained at 300°K and at 78°K on polished single crystals of low iron content: actinolite, olivine, diopside, epidote, chlorite, and enstatite. The spectra cover the range of 400 to 3,500 millimicrons. The single most characteristic feature is a strong band at 1,000 millimicrons due to ferrous iron in six-fold coordination. In diopside and enstatite a band occurs in the low frequency end of the spectrum which appears to be due to ferrous iron in four-fold coordination. Spectral bands assignable to ferric iron occur in the spectra of most minerals studied.—*from* Authors' abstract

7054 **White, William B.** Correlation of caves and erosion surfaces in the Southern Cumberland Valley of Pennsylvania [abs.]: Natl. Speleol. Soc. Bull., v. 28, no. 2, p. 92–93, 1966.

7135 **Williams, George C.** Adaptation and natural selection—A critique of some current evolutionary thought: Princeton, N. J., Princeton Univ. Press, 307 p., illus., 1966.

This book, written for advanced students and professional biologists, takes a stand against the unnecessary use of such concepts as genetic assimilation, group selection and cumulative progress in adaptive evolution and advocates rigorous application of the fundamental ideas of Fisher, Haldane, and Wright in explaining adaptation. Williams reassesses and reinterprets material that has been considered by some to be evidence of the inadequacy of the traditional model of natural selection to explain evolutionary adaptation, and suggests ideas to aid in developing an effective set of principles for dealing with the general phenomenon of biological adaptation.—G.D.C.

Willis, Eric H. *See* Trautman, Milton A. 6992

Wilson, H. D. B. *See* Kilburn, L. C. 6636

7091 **Wilson, J. T.** Some rules for continental drift, *in* Continental drift: Royal Soc. Canada Spec. Pub. 9, p. 3–17, illus., tables, 1966.

Guided by specific regions, and assuming convection currents in near molten mantle beneath brittle crust, the Earth's surface may be distorted by: dilation with grabens and rifts; shearing with large concurrent faults; compression with mountain-building; and flow with metamorphic terrain. Considering these features, tentative rules governing continental drift are: 1, great compression along active primary mountains, with some rotation of sides; 2, shearing along same systems or transcurrent fault zones; 3, expansion at mid-ocean ridges with some rotation of sides; 4, no random deformation of continents nor ocean floors, but all traced to above zones of fracture; 5, mid-ocean ridges end in large transcurrent faults or pinch out to be replaced by compression ranges; 6, aseismic ridges, where mantle generates much lava, show locus of crustal movement past such sources; 7, where two such ridges lead to opposite continents, the ends were once in contact.—G.D.C.

Wolfe, Edward W. *See* Amos, Dewey H. 7151

6911 **Wolfe, Jack A.; Hopkins, D. M.; Leopold, E. B.** Tertiary stratigraphy and paleobotany of the Cook Inlet region, Alaska: U.S. Geol. Survey Prof. Paper 398-A, p. A1–A29, illus., tables, 1966.

Nonmarine sedimentary rocks formerly considered Eocene are shown by study of leaf and pollen floras to be mostly Paleocene (Chickaloon and Wishbone Formations), Miocene, and Pliocene (Kenai and Tsadaka Formations). Three new provincial time-stratigraphic units are proposed for all plant-bearing strata in Alaska of the same age as those parts of the Kenai Formation in the type and reference sections here designated. The Seldovian Stage, with a warm-temperate exotic flora, corresponds to the lower Miocene in northwestern U.S. and Japan; the flora of the Tsadaka Formation is of this stage only. The Homerian Stage, with a relatively provincial flora, corresponds in part to the upper Miocene. The Clamgulchian Stage, with an extremely provincial flora ancestral to living Alaskan species, probably corresponds to part of the Pliocene.—V.M.J.

6662 **Wolff, Ernest Nichols.** The geology of the northern half of the Caviness quadrangle, Oregon [abs.]: Dissert. Abs., v. 26, no. 12, pt. 1, p. 7262, 1966.

7160 **Wood, Fergus J.** (editor-in-chief). The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. I: U.S. Coast and Geod. Survey Pub. 10-3, 263 p., illus., tables, 1966.

Following an introductory section describing the impact of the earthquake, a summary section deals with the Bureau's total mobilization effort. This account is succeeded by a section discussing the seismicity and seismic history of Alaska in relation to the known geologic and tectonic structure of the region, including tables covering Alaskan earthquakes since 1786. Operational Phases, comprising the major part of the volume, describes equipment, and summarizes information and compiled data on the earthquake, as well as procedures used in coordinating all types of studies used to determine causal factors and associated effects. Before-and-after photographs and charts are included. Appendix A gives a record of the Bureau's previous work in Alaska, and Appendix B is a gazetteer of Alaskan place names.—E.S.L.

7215 **Woollard, G. P.; Strange, W. E.** The prediction of gravity, *in* Gravity anomalies—Unsurveyed areas: Am. Geophys. Union Geophys. Mon. Ser., no. 9 (Natl. Acad. Sci.—Natl. Research Council Pub. 1357), p. 96–113, tables, 1966.

The accuracy with which it is possible to predict values of gravity in restricted areas of some gravity control (Rocky Mountain and Big Horn Mountains-Black Hills section) are considered, and it is concluded that: wherever geology, crust, and mantle vary in a regular manner, it is possible to use Bouguer anomaly values with regional spacing of control points as datum for prediction of free-air anomaly values and observed gravity values; geologic considerations should be included where there are marked changes in geology and few control points; and closer spacing of control points gives more reliable prediction, and with adequate distribution, no corrections

for geology are necessary. Procedures for predicting gravity in unsurveyed areas are outlined on the basis of changes in crustal density, relation of crustal thickness to surface elevation, density contrast between crust and mantle, and value of regional isostatic conditions.—V.S.N.

Worthing, Helen W. *See* Dinnin, Joseph I. 7085

Worzel, J. Lamar. *See* Talwani, Manik. 6714

7001 **Wright, Hedley G.** Determination of indicatrix orientation and 2V with the spindle stage—A caution and a test: Am. Mineralogist, v. 51, nos. 5–6, p. 919–924, illus., 1966.

Various methods of determination of 2V are discussed; the "40 degree test" is suggested as the most useful determination of indicatrix orientation.—B.C.H.

Wright, Thomas L. *See* Sato, Motoaki. 6781

7095 **Wu, Francis T.; Hannon, W. J.** PP and crustal structures: Seismol. Soc. America Bull., v. 56, no. 3, p. 733–747, illus., tables, 1966.

Haskell's formulation for P wave reflection at the base of a solid crust is extended to include overlying liquid layers. Calculations made for three models show that the water layer causes the main difference between continental and oceanic reflections. Seismograms from a deep shock are consistent with theoretical records. The PP/P amplitude ratio as a function of frequency obtained from seismograms can be used to decipher the detailed structure at the point of reflection only after the radiation pattern of the source, attenuation of waves during propagation, and crustal transmission response at the receiver are properly taken into account. D.B.V.

6871 **Wu, Tien Hsing.** Soil mechanics: Boston, Mass., Allyn and Bacon, 429 p., illus., tables, 1966.

Index properties and classification comprise the opening chapter of the textbook. Major topics, covered in chapters 2 through 10, are water movement through soils, elastic deformation of soil masses, and failure of soil masses. Each chapter begins with a treatment of fundamental principles, followed by examples of application to common problems, accompanied by a discussion of the reliability and limitations of solutions established by field and laboratory observations. Other chapters cover numerical solutions, properties of natural soil deposits, and properties of the clay fraction.—E.S.L.

6700 **Wuensch, B. J.; Takéuchi, Y.; Nowacki, W.** Refinement of the crystal structure of binnite, $Cu_{12}As_4S_{13}$ [with German abs.]: Zeitschr. Kristallographie, v. 123, no. 1, p. 1–20, illus., tables, 1966.

The crystal structure of binnite has been refined to permit comparison with tetrahedrite. The results of refinement of photographic data are found to be comparable to counter data, but standard deviations of parameters, bond lengths, and bond angles are approximately 50 percent greater. Both binnite and tetrahedrite are superstructures based on a sphalerite-like arrangement of atoms. Displacements from this arrangement are less pronounced in binnite than in tetrahedrite.—E.S.L.

6846 **Wyllie, P. J.; Haas, J. L., Jr.** The system $CaO–SiO_2–CO_2–H_2O$—[Pt.] 2, The petrogenetic model: Geochim. et Cosmochim. Acta, v. 30, no. 5, p. 525–543, illus., 1966.

In each of the three isobaric invariant reactions below 900°C on the vapor-saturated liquidus surface of the system $CaO–SiO_2–CO_2–H_2O$ at 1 kb pressure, the vapor phase is extremely rich in H_2O. The effect of adding H_2O to the vapor phase on the temperatures of successive decarbonation reactions in the system $CaO–SiO_2–CO_2$ is illustrated in the petrogenetic model, and applications to carbonatites are discussed briefly. If an igneous intrusion gives off enough H_2O during crystallization to flush CO_2 gas from the pores of a siliceous limestone in contact with it, partial melting

of the limestone could conceivably occur. This possibility should be considered in studies of thermal metamorphism.—D.B.V.

Yerkes, R. F. *See* Campbell, R. H. 7099

6939 **Young, E. J.; Weeks, A. D.; Meyrowitz, Robert.** Coconinoite, a new uranium mineral from Utah and Arizona: Am. Mineralogist, v. 51, nos. 5–6, p. 651–663, illus., tables, 1966.

Coconinoite, a new hydrous iron uranium phosphate and sulfate from Blackwater No. 4 mine, Arizona, and Jomac mine, Utah, is described. Optical properties, X-ray powder diffraction d-spacings, major-element and spectrographic analyses, and differential thermal analyses are given.—M.L.L.

7114 **Young, E. J.** Heavy minerals in stream sediments of the Connors Pass quadrangle, White Pine County, Nevada, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C108–C112, illus., 1966.

A comparative study of the heavy minerals in the sands being transported from Paleozoic sedimentary and Tertiary volcanic source rocks in the Connors Pass quadrangle in the central part of the Schell Creek Range shows that (1) the abundance of heavy minerals varies directly as their sorting, and (2) the abundance of the opaque minerals varies directly as the median size of the heavy minerals. The first empirical result confirms the theoretical relationship described by Rubey in 1933. Zircon/sphene ratios in 230–325-mesh stream sands derived from limestone are generally 1 or less; those from clastic-rock areas are greater. Higher content of allanite and sphene is found where source rocks are volcanic; higher content of zircon, rutile, and tourmaline where they are clastic.—Author's abstract

Young, J. A. *See* Fairhall, A. W. 7007

7209 **Young, W. E.** Manganese occurrences in the Eureka–Animas Forks area of the San Juan Mountains, San Juan County, Colorado: U.S. Bur. Mines Inf. Circ. 8303, 52 p., illus., 1966.

Large quartz veins in the northeast part of the Silverton caldera contain rhodonite and less common rhodochrosite and unidentified manganese-bearing calcium minerals in addition to base and precious metals for which some of them have been mined. Average manganese content ranges from 8 percent in parts of veins that are several thousand feet long to 20.7 percent in one smaller vein. The veins would be a significant potential source of manganese at some higher price level or in an emergency.—E.R.L.

6687 **Youngquist, Walter.** Ecology of geologists—Need for a course on the geological profession: Jour. Geol. Education, v. 14, no. 1, p. 6–8, 1966.

Geology departments generally do not take time to orient students in the geological profession—to explore vigorously areas other than strictly geology wherein geologists might adapt themselves, or to discuss frankly and fully such matters with students who will soon be launched into the profession. A brief course on the geological profession is strongly recommended.—Author's abstract

6969 **Youngquist, Walter; Heinrich, M. A.** Late Devonian conodonts from the Lost Burro Formation of California: Jour. Paleontology, v. 40, no. 4, p. 974–975, 1966.

A sparse fauna of fragmental conodonts were found in unit 5 of the type section of the Lost Burro Formation. The genera include *Hibbardella, Ligonodina(?), Palmatolepis, and Polygnathus. Palmatolepis distorta* Branson and Mehl was recognized. Elsewhere, it ranges through the middle portion of Late Devonian time.—R.C.D.

Yund, R. A. *See* Kullerud, G. 6637

6899 **Zablocki, C. J.** Electrical transients observed during underground nuclear explosions: Jour. Geophys. Research, v. 71, no. 14, p. 3523-3542, illus., tables, 1966.

Electrical transients were recorded from 12 underground nuclear explosions. The electrical field components are only a few mv per m at distances less than 10 km from the shot point, and they generally decay approximately as the inverse cube of distance. Magnitudes are proportional to about the 0.4 power of yield. Two source mechanisms are considered: the formation of an elementary magnetic dipole by the conducive plasma expanding in the Earth's magnetic field, and the formation of an elementary electric dipole by radial asymmetry in the generation and absorption of β rays. The data accordingly were interpreted in terms of equivalent buried dipole sources.—D.B.V.

Zartman, R. E. *See* Heyl, A. V. 7121

Zietz, Isidore. *See* King, Elizabeth R. 6787

Zuehlke, Carl W. *See* Przybylowicz, Edwin P. 6976

INDEX

[The numbers refer to entries in the abstracts]

Absolute age, dates
Carbon-14
Alaska, Bahamas, Indiana, Packard Instrument Co. laboratory, list: Kowalski, Sandra J. 7016
Alaska, peat: Brown, Jerry. 7182
Atlantic Ocean, Caribbean Sea, inorganic material: Olsson, Ingrid U. 6735
Bahamas, oolitic sands: Martin, Ernest L. 6719
British Columbia, sites, archeological, Fraser Canyon, early man: Borden, Charles E. 6895
Canada, Geological Survey of Canada laboratory, list: Dyck, W. 6947
Canada, U.S., sites, archeological, Great Plains: Neuman, Robert W. 6756
Carbonates, comparison with thorium-uranium: Thurber, David L. 6909
Colorado, stone-bank terraces, Niwot Ridge, A-soil: Benedict, James B. 7098
Deviation, historical and tree-ring, fifth millennium: Libby, Willard F. 6902
Florida and Alabama, Florida State Univ. laboratory, list: Stipp, J. J. 6986
Great Lakes region, Lake Erie area, interstadial samples: Dreimanis, Aleksis. 6720
Greenland, Copenhagen National Museum laboratory, list: Tauber, Henrik. 7012
Greenland, icecap, Tuto Tunnel: Oeschger, Hans. 6754
Greenland, Mesters Vig, Skeldal area, shells: Lasca, Norman Paul, Jr. 6657
Guatemala and Costa Rica, Gif-sur-Yvette laboratory, list: Coursaget, J. 6948
Man, fossil, sites, North America: Johnson, Frederick. 6721
Minnesota, peat, growth rate: Farnham, R. S. 6945
Missouri and Kansas, Gakushuin Univ. laboratory, list: Kigoshi, Kunihiko. 6946
Nevada, Pintwater Cave, coprolite: Berger, Rainer. 6901
North America, Geochron Laboratories, list: Krueger, Harold W. 6991
North America, Inst. Venezolano Inv. Cientificas laboratory, list: Tamers, M. A. 7011
North America, Michigan Univ. laboratory, list: Crane, H. R. 7013
North America, Pennsylvania Univ. laboratory, list: Stuckenrath, Robert, Jr. 7015
North America, sites, archeological, early man: Haynes, C. Vance, Jr. 6739
Quebec, National Physical Laboratory, list: Callow, W. J. 7014
Texas, Atascosa County, water, Carrizo Sand: Pearson, F. J., Jr. 6737
Texas, Louisiana, Mexico, Oregon, Texas Univ. laboratory, list: Pearson, F. J., Jr. 7017
Absolute age, dates
Carbon-14
United States and Canada, Wisconsin Univ. laboratory, list: Bender, Margaret M. 7009
United States and Costa Rica, Smithsonian Inst. laboratory, list: Long, Austin. 6944
United States and Mexico, Arizona Univ. Geochronology Laboratories, list: Haynes, C. Vance, Jr. 6985
United States and Mexico, UCLA laboratory, list: Berger, Rainer. 6942
United States, Canada, Greenland, Isotopes, Inc. laboratory, list: Trautman, Milton A. 6992
United States, eastern, archeological: Griffin, James B. 6755
Utah, wood, denudation rate: Eardley, A. J. 6959
Washington, British Columbia, Alaska, Univ. Washington laboratory, list: Fairhall, A. W. 7007
Wisconsin, Two Creeks area, Victoria Institue of Applied Science: Bermingham, Anne. 7008
Granitic rocks
Alaska, Wrangell and Chugach Mountains: Grantz, Arthur. 7105
Colorado, Lake George beryllium area, Redskin Granite and greisen: Hawley, C. C. 7119
Nevada and Utah, K-Ar, synchronous plutonic and volcanic: Armstrong, Richard Lee. 6889
Igneous rocks
Pegmatite, Mount Rosa area: Gross, Eugene B. 6699
United States, western, plutons, metamorphic effects: Ramspott, L. D. 6792
West Indies, Aruba, quartz-diorite batholith: Priem, H. N. A. 7204
Interpretation
Continental crust, chronologic development, heterogeneity: Wasserburg, G. J. 6837
Man, fossil
Evolution, transitions: Oakley, Kenneth P. 6730
Meteorites
Estherville, Pasamonte, I-Xe, Pu-Xe formation intervals: Pepin, Robert O. 6904
Sedimentary rocks
Colorado, Uncompahgre uplift: Cater, Fred W. 7111
Absolute age, methods
Carbon-14
Accuracy, relation to true age, review: Stuiver, Minze. 7010
Application to archeology, education program: Stuckenrath, R., Jr. 6734
Application to archeology, interdisciplinary approach: Davis, E. Mot. 6733
Arctic, archeological sites, characteristics affecting: Campbell, John M. 6731
Bones, collagen separation: Krueger, Harold W. 6907

Absolute age, methods
Carbon-14
Carbonate, ground water, Texas: Pearson, F. J., Jr. 6737
Errors, causes, paleomagnetism, carbon variation: Libby, Willard F. 6736
Foraminifera tests, contamination sources, experimental studies: Olsson, Ingrid U. 6735
Ice, polar: Oeschger, Hans. 6754
Liquid scintillation, techniques: Tamers, Murry A. 6898
Liquid scintillation, techniques, advances: Noakes, John E. 6753
Man, fossil: Oakley, Kenneth P. 6730
Methane production, batch reactor: Olson, Edwin A. 6752
Methane production, technique: Long, Austin. 6751
Significance: Libby, Willard F. 6902
Soil profiles: Dimbleby, G. W. 6732
Tree-ring data, application: Bannister, Bryant. 6738
Wood, atmospheric C-14, fluctuation, effect: Damon, Paul E. 6715
Wood, discrepancies, causes: Schell, William R. 6910
General
Sample preparation, mica, concentration by flotation: Davies, Raymond. 6783
Potassium-argon
Activation, Ar-39 produced by K-39 (n,p) reaction: Merrihue, Craig. 6722
Argon analysis, neutron activation: Armstrong, Richard Lee. 6889
Thorium-uranium
Carbonates, cf., C-14: Thurber, David L. 6909
Uranium-uranium
Carbonate, Pleistocene deposits, dating potential: Thurber, David Lawerence. 6769
Alabama
Absolute age
C-14, Florida State Univ. laboratory, list: Stipp, J. J. 6986
Economic geology
Bauxite, Eufaula: Clarke, Otis M., Jr. 7162
Chromium, southeastern, brown iron ore, enrichment: Smith, W. Everett. 6982
Diatomite, Waterloo district: Clarke, Otis M., Jr. 6983
Stratigraphy
Pennsylvanian, coal beds, Sand and Lookout Mts., correlation: Shotts, Reynold Q. 6965
Alaska
Absolute age
C-14, Instituto Venezolano Inv. Cientificas laboratory, list: Tamers, M. A. 7011
C-14, Packard Instrument Company laboratory, list: Kowalski, Sandra J. 7016
C-14, Univ. Washington laboratory, list: Fairhall, A. W. 7007
Carbon-14, peat: Brown, Jerry. 7182
Alaska
Absolute age
Wrangell and Chugach Mountains, granodiorite: Grantz, Arthur. 7105
Earthquakes
1964, Prince William Sound, U.S. Coast and Geodetic Survey studies: Wood, Fergus J. 7160
March 29, 1964, free oscillations, Earth: Nowroozi, Ali Asghar. 6660
March 28, 1964, ocean tide loads, triggering effect: Berg, Eduard. 6864
Seismicity, 1786-1964: Wood, Fergus J. 7160
Economic geology
Iron, southeastern: Taylor, Hugh P., Jr. 6653
Tin, Cape Creek, submarine drilling, problems: Howard, Thomas E. 7168
Hydrogeology
Fairbanks area, silt, moisture movement below freezing temperature: Hoekstra, Pieter. 6941
Mineralogy
Pyrophyllite, Brooks Range, Kekiktuk Conglomerate: Reed, Bruce L. 7080
Paleontology
Fauna, Mesozoic, upper, Wrangell Mts.: Grantz, Arthur. 7105
Flora, Tertiary, Cook Inlet region, correlation, time-stratigraphic units: Wolfe, Jack A. 6911
Microfauna, Cretaceous, northern, zones, correlation: Bergquist, Harlan R. 6824
Petrology
Rainbow Mountain-Gulkana Glacier area, polymetamorphic rocks: Ragan, Donal M. 6828
Ultramafic complexes: Taylor, Hugh P., Jr. 6653
Sedimentary petrology
Howard Pass area, soils: MacNamara, Edlen E. 6659
Stratigraphy
Cretaceous, northern, microfaunal correlation: Bergquist, Harlan R. 6824
Mesozoic, upper, southwestern Wrangell Mts.: Grantz, Arthur. 7105
Tertiary, Cook Inlet region, floral correlation, time-stratigraphic units: Wolfe, Jack A. 6911
Structural geology
Tectonic setting and major faulting: Wood, Fergus J. 7160
Alberta
Geochemistry
Formation-waters, analysis, petroleum exploration, recommendations: Noad, D. F. 6826
Hydrogeology
Ghostpine Creek valley, ground-water flow, prairie environment, mapping: Toth, J. 7026

Algae
Cambrian
Tennessee, Copper Ridge Dolomite, structures: Harris, Leonard D. 7106

Aluminum
Abundance
Earth's crust, summary, mineralogy, properties, chemical analysis: Farrah, G. H. 6980
Analysis
Chemical methods, separation and determination procedures: Farrah, G. H. 6980

Angiosperms
Tertiary
Alaska, Cook Inlet region, floral correlation, time-stratigraphic units: Wolfe, Jack A. 6911

Anthozoa
Quaternary
Barbados, coral cap, reef terraces: Russell, R. J. 6813

Appalachians
Geochemistry
Great Valley, zinc deposits, lead isotopes: Heyl, A. V. 7121

Arctic
Absolute age
Archeological sites, C-14, characteristics affecting: Campbell, John M. 6731
General
Bibliography, pre-1800, Arctic Inst. North America Library: Corley, Nora T. 7024
Current research, Canada, northern, geophysical and geological: vanSteenburgh, W. E. 7070
Education and research, Arctic Institute of North America: Reed, John C. 7062
Geomorphology
Canadian Archipelago, submarine physiography, relation to crustal movements: Pelletier, B. R. 7040

Arctic Ocean
Geophysical surveys
Beaufort Sea, seismic, crust, structure: Milne, A. R. 7093
North American portion, magnetic: King, Elizabeth R. 6787
Maps
Magnetic, North American portion: King, Elizabeth R. 6787
Structural geology
North American portion, magnetic data: King, Elizabeth R. 6787

Arizona
Economic geology
Beryllium, southern: Shawe, D. R. 7084
Evaporites, Holbrook basin, genesis: Peirce, H. Wesley. 6915
Geophysical surveys
Flagstaff area, P wave attenuation, lava, ash, limestone: deBremaecker, J. C. 6914

Arizona
Hydrogeology
Santa Cruz River basin, ground-water recharge, model study: Matlock, W. G. 7208
Tucson Basin, ground water, movement, recharge, C-14 dating: Bennet, Richmond. 6717
Maps
Structure, northeastern: Scurlock, J. R. 6874
Mineralogy
Coconinoite, Blackwater No. 4 mine, new: Young, E. J. 6939
Coesite and stishovite, Meteor Crater, isolation from Coconino Sandstone: Bohn, Ernst. 7131
Stratigraphy
Permian, Supai Formation, Holbrook basin, evaporite deposits: Peirce, H. Wesley. 6915

Arkansas
Paleontology
Pteridophytes, Mississippian, Fayetteville Formation, *Lepidophloios*: Mapes, Royal H. 6845

Artesian waters and wells
Flow problems
Drawdown in homogeneous anisotropic aquifers, solutions: Hantush, Mahdi S. 6867

Arthropoda
Tertiary
California, Barstow Formation, nodules, study technique: McLaughlin, R. B. 6844

Asbestos
Properties
Morphology, nitrogen adsorption data: Naumann, A. W. 6995

Associations
Arctic Institute of North America
Education and research programs, cooperation, support: Reed, John C. 7062
Library collection, pre-1800 books, bibliography: Corley, Nora T. 7024
International Conference on Earth Sciences
Massachusetts Institute of Technology, advances, 1964: Hurley, P. M. 6842
Montana Bureau of Mines and Geology
Coal Resources Symposium, proceedings: Groff, S. L. 6804
Northern Ohio Geological Society
Symposium on salt, 2d: Rau, Jon L. 6924
Royal Society of Canada
Symposium, continental drift, review of evidence: Garland, G. D. 7092

Atlantic Coastal Plain
Economic geology
Phosphate, genesis: McConnell, Duncan. 7163
Geomorphology
Southeastern, fluvial cycle, stages: Colquhoun, D. J. 6640
Hydrogeology
Northern, ground water, fresh and salty, relations: Upson, Joseph E. 7089
Paleontology
Bryozoa, lectotype designations: Greeley, Ronald. 6968

Atlantic Ocean
Geophysical surveys
Continental shelf, Nova Scotia, gravity and seismic: Keen, Charlotte. 6897
Continental shelf, Nova Scotia, seismic: Berger, Jon. 7041
Puerto Rico Trench, Mid-Atlantic Rise, gravity anomalies, tectonic model: Morgan, W. Jason. 6908
Puerto Rico Trench, Mid-Atlantic Rise, gravity anomalies, tectonics, model: Talwani, Manik. 6714
Maps
Aeromagnetic, Scotian Shelf: Canada Geological Survey. 6635
Marine geology
Sediments, grain-size analysis, sedimentation tube: Schlee, John. 6970
Paleoclimatology
Quaternary, temperatures, faunas, island, endemism: Briggs, John C. 6796
Structural geology
Puerto Rico Trench, Mid-Atlantic Rise, tectonics, model: Morgan, W. Jason. 6908
Puerto Rico Trench, Mid-Atlantic Rise, tectonics, model: Talwani, Manik. 6714
Atmosphere
Composition
Carbon dioxide, paleoatmosphere: Eugster, Hans P. 6728
Radon, thoron, diurnal oscillations: Staley, D. O. 6727
Automatic data processing
General
Storage and retrieval of data, problem solving by computers: Merriam, Daniel F. 6875
Geophysical surveys
Gravity net data, extension to unsurveyed areas: Heiskanen, W. A. 7072
Gravity net data, extension to unsurveyed areas: Rapp, Richard. 7195
Hydrogeology
Ground-water evaporation, soils, losses, theoretical prediction: Liakopoulos, Aristides C. 6880
Water-quality data, Kansas: Morgan, C. O. 7206
Aves
Dissourodes milleri n. gen. n. sp.
Tertiary, Nebraska, Pliocene: Short, Lester L., Jr. 7145
Geographic distribution
Ecology, evolution, geological timetable: Amadon, Dean. 6876
Bacteria
Paleozoic
Living microorganisms, rock salt crystals, primary fluid inclusions: Dombrowski, H. J. 6918
Bahamas
Absolute age
C-14, Packard Instrument Company laboratory, list: Kowalski, Sandra J. 7016
Oolitic sands, Great Bahama Bank, C-14: Martin, Ernest L. 6719
Bahamas
Sedimentary petrology
Great Bahama Bank, oolith, formation: Martin, Ernest L. 6719
Barbados
Geomorphology
Coral cap, reef terraces and karst: Russell, R. J. 6813
Paleontology
Quaternary, coral cap, reefs: Russell, R. J. 6813
Structural geology
Uplifts, reef terraces: Russell, R. J. 6813
Barium
Abundance
Earth's crust, summary, mineralogy, isotopes: Turekian, Karl K. 7021
Analysis
Chemical methods, separation and determination procedures: Turekian, Karl K. 7021
Basins, structural
Evolution
Tectonic behavior, stratigraphic succession, cratonic sequences: Sloss, L. L. 6937
Bauxite
Genesis
Sinkhole deposits: Clarke, Otis M., Jr. 7162
Beryllium
Arizona
Occurrences: Shawe, D. R. 7084
Nevada
Occurrences: Shawe, D. R. 7084
New Mexico
Occurrences: Shawe, D. R. 7084
Utah
Occurrences: Shawe, D. R. 7084
Bibliography
Arctic
Pre-1800, Arctic Inst. North America Library: Corley, Nora T. 7024
Authors
Bucher, Walter Herman: Rouse, John T. 6784
Holmes, Arthur: Cahen, L. 7123
Riggs, Robert Jennings: Morley, Harold T. 6785
Schoewe, Walter H.: Jewett, John Mark. 6786
Spencer, Arthur Coe: Hoy, Robert B. 7166
Marine geology
Selected references for reading course: Schubel, J. R. 7138
Montana
Ground-water studies: Botz, Maxwell K. 6672
Oklahoma
Geology, 1965: Howe, Jane. 6843
Biography
Bucher, Walter Herman
Bibliography: Rouse, John T. 6784
Holmes, Arthur
Bibliography: Cahen, L. 7123
Richards, Edward Franklin: Jones, Walter B. 7165
Riggs, Robert Jennings
Bibliography: Morley, Harold T. 6785

Biography
Schoewe, Walter H.
Bibliography: Jewett, John Mark. 6786
Spencer, Arthur Coe
Bibliography: Hoy, Robert B. 7166
Brachiopoda
Devonian
Nevada, Roberts Mts., Denay Limestone: Johnson, J. G. 6869
Eridmatus texanus, n. comb.
Pennsylvanian, Oklahoma–Texas, taxonomy, nomenclature, range: Branson, Carl C. 6935
Neospirifer texanus (Meek)
Pennsylvanian, Oklahoma–Texas, assigned to *Eridmatus*, n. gen.: Branson, Carl C. 6935
Reticulariina cf. R. spinosa
Mississippian, Oklahoma, Vinita area, Fayeteville Shale: Branson, Carl C. 6932
Stringocephalus
Devonian, Indiana, Miami Bend Formation, correlation: Cooper, G. Arthur. 7144
Subrensselandia
Devonian, Indiana, Miami Bend Formation, correlation: Cooper, G. Arthur. 7144
Vallomyonia devonicum n. comb.
Devonian, Nevada, Roberts Mts., Denay Limestone: Johnson, J. G. 6869
Breccia
Intrusive
Ontario, Sudbury: Cowan, J. C. 6763
Ontario, Sudbury: Souch, B. E. 6773
Brines
Experimental studies
Trona deposition, temperature, pressure, saturation controls: Eugster, H. P. 6680
Exploration
Well logging: Bird, James M. 6893
Geochemistry
Formation-waters, analysis, recommendations: Noad, D. F. 6826
Isotopes, δO-18 values: Lloyd, R. M. 6857
Utah
Paradox basin, Pennsylvanian, Mississippian, Devonian, possibilities: Mayhew, E. J. 6919
British Columbia
Absolute age
C-14, Fraser Canyon, early man, sites, archeological: Borden, Charles E. 6895
C-14, Univ. Washington laboratory, list: Fairhall, A. W. 7007
Hydrogeology
Fraser Valley, Aldergrove test hole, unconsolidated deposits: Halstead, E. C. 6800
Paleontology
Man, fossil, Quaternary, Fraser Canyon, sites, C-14 dates: Borden, Charles E. 6895
Bromine
Geochemistry
Evaporite, brine depth, basal salt bromide ratio, theory of profiles: Holser, William T. 6920
Bromine
Geochemistry
Halite, Paradox salt beds, Utah, disribution: Raup, Omer B. 6761
Water, natural, sedimentary basins: Anderson, Raymond J. 6825
Bryozoa
Nomenclature
Lectotype designations: Greeley, Ronald. 6968
Calcium
Abundance
Earth's crust, summary, cf. barium and strontium: Turekian, Karl K. 6978
Analysis
Chemical methods, separation and determination procedures: Turekian, Karl K. 6978
Geochemistry
Water, natural, sedimentary basins: Anderson, Raymond J. 6825
Properties
Isotopic and atomic: Turekian, Karl K. 6978
California
Earthquakes
June 27–29, 1966, Parkfield, damage: Steinbrugge, Karl V. 7069
June 27–29, 1966, Parkfield, motion, high acceleration: Cloud, William K. 7071
June 27–29, 1966, Parkfield, portable seismic station data: Pakiser, L. C. 7029
June 27–29, 1966, Parkfield, pre- and post-earthquake fault slippage: Allen, Clarence R. 6949
June 27–29, 1966, Parkfield, seismic data, fault-plane solution: McEvilly, T. V. 7061
November 16, 1964, Corralitos area, aftershock sequence, analysis: McEvilly, Thomas V. 7094
Prediction, probability model: Epstein, B. 7164
Economic geology
Evaporites, Searles Lake area, prospecting, guides: Smith, George I. 6668
Mineral resources, Cady Mountains quadrangle: Dibblee, T. W., Jr. 6701
Engineering geology
Earthquakes, building response, San Francisco, Wells Fargo Building: Medearis, Kenneth. 7057
Earthquakes, Parkfield, 1966, building damage: Steinbrugge, Karl V. 7069
Shorelines, littoral drift determination, methods: Johnson, J. W. 7201
General
Division of Mines and Geology, meteorite collection: Mathews, Robert A. 7153
Geochemistry
Kramer area, lake beds, borates, chemical zonation: Bowser, C. J. 6853
Sierra Nevada, uranium, thorium, distribution, soils: Hansen, Richard Oto. 6684

California
Geochemistry
Sonoma County, glaucophane schist in Franciscan Formation, analyses: Lee, Donald E. 7120
Geomorphology
San Gabriel Mountains, soil erosion, water repellence, wildfire effects: Debano, L. F. 7025
Maps
Geologic: U.S. Geological Survey. 6670
Geologic, Cady Mountains quadrangle: Dibblee, T. W., Jr. 6701
Geologic, Cholame Valley area, San Andreas rift: Dickinson, William R. 7063
Mineralogy
Analcime, exchange capacity, Hector: Ames, L. L., Jr. 7033
Chabazite, San Bernardino County, Barstow Formation: Gude, Arthur J., 3d. 6987
Heavy minerals, Stanford University area, Tertiary sandstones: Tieh, Thomas Ta-pin. 6664
Mojave Desert, playa crusts: Langer, Arthur M. 6663
Sonoma County, Franciscan Formation, glaucophane schist member: Lee, Donald E. 7120
Paleoclimatology
Quaternary, Pleistocene, central: Addicot, W. O. 6644
Paleontology
Arthropoda, Miocene, Barstow Formation, Calico Mts., nodules: McLaughlin, R. B. 6844
Conodonts, Devonian, Lost Burro Formation, Panamint Range: Youngquist, Walter. 6969
Invertebrata, Pleistocene, central, assemblages, paleoecology: Addicott, W. O. 6644
Mollusca, Pleistocene, San Pedro, second terrace, list: Chace, Emery P. 7157
Petrology
Cady Mountains quadrangle: Dibblee, T. W., Jr. 6701
Jadeite rocks, blue schists, source rocks: Bloxam, T. W. 6958
Sonoma County, Franciscan Formation, glaucophane schist: Lee, Donald E. 7120
Sedimentary petrology
Santa Paula Creek, Pico Formation, sedimentary structures: Crowell, John C. 6647
Ventura County, Cretaceous series, Upper, depositional features: Rust, B. R. 6831
Stratigraphy
Cretaceous, Upper series, Ventura County, paleogeography: Rust, B. R. 6831
Mesozoic–Cenozoic, Castle Mtn. Range: Dickinson, William R. 7063
Mesozoic–Quaternary, Cady Mountains quadrangle: Dibblee, T. W., Jr. 6701
Precambrian–Cambrian, southern Great Basin, correlation: Stewart, John H. 7109

California
Stratigraphy
Quaternary, Searles Lake, Pleistocene, Recent, saline deposits: Smith, George I. 6668
Tertiary, Kramer beds, Boron area, borate and claystone facies: Barnard, Ralph M. 6852
Tertiary, Pico Formation, Santa Paula Creek section: Crowell, John C. 6647
Structural geology
Boron area, Kramer borate lake beds, faults and folds: Barnard, Ralph M. 6852
Calaveras County, Wool Hollow Cave, joints, slippage with earth tides: Davis, S. N. 7055
Cholame Valley and Castle Mtn. Range, San Andreas fault: Dickinson, William R. 7063
Santa Monica Mountains, central, thrust faults: Campbell, R. H. 7099
Cambrian
California
Spring Mountains–Death Valley and White–Inyo Mts. regions, correlation: Stewart, John H. 7109
Colorado
Central, western, Upper formations: Lewis, John Hubbard. 6658
Nevada
Spring Mountains–Death Valley region, stratigraphy, correlation: Stewart, John H. 7109
New York
North Chatham area, Taconic sequence, trilobite faunule, new: Raseti, Franco. 7132
Canada
Absolute age
C–14, archeological, Great Plains: Neuman, Robert W. 6756
C–14, Geological Survey of Canada laboratory, list: Dyck, W. 6947
C–14, Isotopes, Inc. laboratory, list: Trautman, Milton A. 6992
C–14, Wisconsin Univ. laboratory, list: Bender, Margaret M. 7009
Economic geology
Nickel, general: Kilburn, L. C. 6636
Tin, occurrences: Mulligan, Robert. 6799
General
Current research, Arctic region, geophysical and geological: vanSteenburgh, W. E. 7070
Geochemistry
Alberta basin, Elk Point evaporites, bromide profiles, halite: Holser, William T. 6920
Eastern, Cumberland basin, Mississippian evaporites, bromine, potash possibilities: Baar, C. A. 6849
Geomorphology
Arctic region, submarine physiography, relation to crustal movements: Pelletier, B. R. 7040
Geophysical surveys
Regional mapping program, status 1964: Innes, M. J. B. 7221
Glacial geology
Moraines, till–stone orientation, Hind's theory: Elson, John A. 6811

Canada
Maps
Geologic projects, Geological Survey, 1966: Canada Geological Survey. 6671
Gravity series, listing to 1964: Innes, M. J. B. 7221
Metallogenic, tin occurrences: Mulligan, Robert. 6799
Tectonic, aeromagnetic, Maritime Provinces, Cabot fault zone: Cameron, H. L. 7042
Paleomagnetism
Easternmost region, potential application to structural problems: Deutsch, Ernst R. 7043
Paleontology
Flora, Devonian–Mesozoic, eastern, Eurasian correlation, continental drift: Radforth, N. W. 7019
Gastropoda, Devonian, western, *Orecopia*, late Frasnian age: Pedder, A. E. H. 6884
Structural geology
Arctic and eastern seaboard, evidence of continental drift: Garland, G. D. 7092
Maritime Provinces, Cabot fault zone: Cameron, H. L. 7042
Carbon
Abundance
Paleoatmosphere, CO_2 content: Eugster, Hans P. 6728
Carboniferous
Oklahoma
Marshall, Bryan Counties, stratigraphy: Beckman, W. A., Jr. 6805
Caribbean region
Volcanology
Magmatic products, Cretaceous–Recent, crust source, questioned: Weyl, Richard. 6767
Caves
Features
Bedding-plane anastomoses, phreatic origin, cavern extension: Ewers, Ralph O. 7030
South Dakota, Bethlehem and Jewel Caves, pebbles, polished: Deal, Dwight E. 7056
South Dakota, Jewel Cave, mud stalagmites: Deal, Dwight E. 7038
Speleothems, growth rate, manmade cave, Kansas: Siegel, Frederic R. 7159
Iowa
Level Crevice Cave, Dubuque, Galena dolomite, solubility: Morehouse, David F. 7051
Kansas
Northeastern, manmade, speleothems, growth: Siegel, Frederic R. 7159
Pennsylvania
Cumberland Valley, southern, correlation with erosion surfaces: White, William B. 7054
Cenozoic
Costa Rica
Southern, Coastal Range, petrology, stratigraphy, structure: Henningsen, Dierk. 6666
Central America
Volcanology
Magmatic products, Cretaceous–Recent, crust source, questioned: Weyl, Richard. 6767
Changes of level
Arctic
Canadian Archipelago, post–Pleistocene vertical movement: Pelletier, B. R. 7040
Mississippi Valley
Quaternary, Embayment, terraces, marine: Cooke, C. Wythe. 6793
Chemical analysis
General
Aluminum, separation and determination: Farrah, G. H. 6980
Calcium, separation and determination: Turekian, Karl K. 6978
Gold, separation and determination: Herz, Nathaniel. 6977
Methods, Al, Ca, Au, Ru–Ra, Ag, Sr–Ba: Kolthoff, I. M. 6981
Radon and radium, separation and determination: Sedlet, Jacob. 6979
Sample preparation, mica, concentration by flotation: Davies, Raymond. 6783
Silver, separation and determination: Przybylowicz, Edwin P. 6976
Strontium and barium, separation and determination: Turekian, Karl K. 7021
Wet
Mercury in sulfide ore, Penfield tube–dithizone: Dinnin, Joseph I. 7085
Chromite
Genesis
Podiform deposits: Thayer, T. P. 6651
Geochemistry
Compositional variation: Jackson, Everett D. 6765
Experimental studies, oxygen fugacity: Ulmer, Gene C. 6650
Muskox intrusion: Irvine, T. N. 6649
Chromium
Alabama
Southeastern, brown iron ore, enrichment: Smith, W. Everett. 6982
Clay mineralogy
Areal studies
California, Mojave Desert, playa crusts: Langer, Arthur M. 6663
Utah, Willard Reservoir, weathering effect on mica–type structures: Guven, Necip. 7005
Experimental studies
Gibbsite, formation from hydroxy-aluminum solutions: Hsu, Pa Ho. 7148
Mica–type minerals, structure, weathering effect: Guven, Necip. 7005
Muscovite, potassium extraction: Reed, M. G. 7079
Mineral data
Al–bentonites, Wyoming: Brydon, J. E. 7006
Illite, mixed–layer illite–montmorillonite: Hower, John. 6989

Clay mineralogy
Mineral data
Pyrophyllite, Alaska, Brooks Range, Kekiktuk Conglomerate: Reed, Bruce L. 7080
Terminology
Regular or random interstratifications: Bloss, F. Donald. 7004
Coal
Kentucky
Martin quadrangle, resources: Rice, Charles L. 7136
Milo and Webb quadrangles, resources: Jenkins, Evan C. 7149
Montana
Eastern, resources: Averitt, Paul. 6802
Mining history: Morgan, Thomas. 6801
Resources: Bateman, Andrew F., Jr. 6803
Resources, symposium: Groff, S. L. 6804
United States
Sulfur analyses: Walker, F. E. 7210
Collections
Meteorites
California Division Mines and Geology: Matthews, Robert A. 7153
Colorado
Absolute age
Boulder County, Niwot Ridge, terraces, stone-bank, A-soil: Benedict, James B. 7098
Lake George beryllium area, Redskin Granite and greisen: Hawley, C. C. 7119
Pegmatites, Mount Rosa area: Gross, Eugene B. 6699
Uncompahgre uplift and Unaweep Canyon: Cater, Fred W. 7111
Economic geology
Manganese, San Juan County, Eureka-Animas Forks area: Young, W. E. 7209
Engineering geology
Materials, properties, elasticity, granitic rocks in tunnels: Carroll, Roderick D. 7103
Rock mechanics, Silver Plume Granite, relation to structures and application: Nichols, Thomas C., Jr. 7104
Geochemistry
Lake George beryllium area, Pikes Peak and Redskin Granites: Hawley, C. C. 7119
Lead, ore, isotope ratios: Delevaux, M. H. 7082
Geomorphology
Boulder County, Niwot Ridge, terraces, stone-bank: Benedict, James B. 7098
Tenmile Range, alpine mudflows: Curry, Robert R. 7067
Uncompahgre Plateau, Unaweep Canyon, wind gap: Cater, Fred W. 7111
Geophysical surveys
Colorado Mineral Belt, gravity, magnetic: Case, J. E. 7172
Uncompahgre Plateau, gravity, magnetic, anomalies, correlation with geology: Case, James E. 6780
Wet Mountains, radioactivity: Singewald, Q. D. 7102
Colorado
Mineralogy
Mount Rosa area, pegmatites: Gross, Eugene B. 6699
Petrology
Central, western, Cambrian rocks, Upper, diagenesis: Lewis, John Hubbard. 6658
Lake George beryllium area, Redskin Granite and associated rocks: Hawley, C. C. 7119
Mount Rosa area, pegmatite dikes: Gross, Eugene B. 6699
Sedimentary petrology
Minturn Formation: Boggs, Sam, Jr. 6808
Stratigraphy
Cambrian, Upper, central, western: Lewis, John Hubbard. 6658
Oligocene, Florissant Lake deposits, laminations, paleoecology: McLeroy, Carol Ann. 6829
Pennsylvanian, Minturn Formation, central: Boggs, Sam, Jr. 6808
Precambrian, subdivision, Uncompahgre Plateau, geophysical data: Case, James E. 6780
Structural geology
Straight Creek area, Silver Plume Granite, fractures: Lee, Fitzhugh T. 7202
Wet Mountains, Ilse fault zone: Singewald, Q. D. 7102
Connate water
Composition
Calcium and bromide contents, sedimentary basins: Anderson, Raymond J. 6825
Connecticut
Engineering geology
Highways, metamorphic rocks, slope design: Siebert, H. 7191
Conodonts
Devonian
California, Panamint Range, Lost Burro Formation: Youngquist, Walter. 6969
Continental drift
Causes
Mantle convection motions, thermal instability, oceanic ridges: Elsasser, Walter M. 6834
Crustal structure
Canada, Maritime Provinces, Cabot fault zone: Cameron, H. L. 7042
Fault patterns, ocean floors, significance: Menard, H. W. 6855
Northwest Territories, Greenland, fracture lineaments: Hilgenberg, Ott Christoph. 6667
General
Symposium, theory, review of evidence: Garland, G. D. 7092
Mantle structure
Geophysical evidence, drift mechanism: MacDonald, Gordon J. F. 7044
Mechanism
Geophysical evidence, mantle properties: MacDonald, Gordon J. F. 7044
Systems, tentative rules: Wilson, J. T. 7091

Continental drift
Paleobotany
Distribution, adaptation to latitude changes: Radforth, N. W. 7019
Paleomagnetism
Time span, velocity estimates: Deutsch, Ernst R. 7043
Rate
Astronomical evidence, observations, last 50 years: Tanner, R. W. 7039
Theoretical support
Mechanical properties required, geophysical and geodetic evidence: MacDonald, Gordon J. F. 6836
Continental shelf
Arctic
Canadian Archipelago, physiography, relation to crustal movements: Pelletier, B. R. 7040
Atlantic Ocean
Nova Scotia, crust and mantle structure, seismic, gravity data: Keen, Charlotte. 6897
Nova Scotia, geomorphology, seismic surveys: Berger, Jon. 7041
General
Current research, interagency conference, proceedings: Taney, Norman E. 6646
Continental slope
Atlantic Ocean
Nova Scotia, crust, mantle structure, seismic, gravity data: Keen, Charlotte. 6897
Continents
Absolute age
Crustal development: Wasserburg, G. J. 6837
Evolution
Permanency, global shear patterns: Menard, H. W. 6855
Copper
Geochemistry
Chalcopyrite synthesis: Barnard, W. M. 7167
Experimental studies: Craig, J. R. 6638
Experimental studies: Kullerud, G. 6637
Ontario
Sudbury: Cowan, J. C. 6763
Sudbury: Souch, B. E. 6773
Quebec
Gaspe, Holland township, occurrence: Brummer, J. J. 6797
Utah
Bingham, sulfur isotopes: Field, Cyrus W. 7184
Core
Composition
Elements, primordial: Ringwood, A. E. 6928
Outer, shock compression studies: Balchan, A. S. 6713
Experimental studies
Shock compression, composition: Balchan, A. S. 6713
Correlation
Methods
Isotopic data, continental crust, Precambrian chronology: Wasserburg, G. J. 6837
Principles
Zone, use of term: Berry, William B. N. 6776
Costa Rica
Absolute age
C-14, Gif-sur-Yvette laboratory, list: Coursaget, J. 6948
C-14, Smithsonian Inst. laboratory, list: Long, Austin. 6944
Petrology
Pacific slope, volcanic-marine sediment section, oceanic crust: Weyl, Richard. 7161
Southern, Coastal Range, Cretaceous-Recent volcaniclastics: Henningsen, Dierk. 6666
Stratigraphy
Cenozoic, Coastal Range, southern: Henningsen, Dierk. 6666
Structural geology
Southern, Coastal Range, folds, faults: Henningsen, Dierk. 6666
Cretaceous
Alaska
Northern, microfaunal correlation: Bergquist, Harlan R. 6824
California
Ventura County, Upper series: Rust, B. R. 6831
Texas
Northeastern, Austin Group: Lokke, Donald H. 6912
Crinoidea
Allagecrinidae
Devonian-Permian, taxonomy, new genera, evolution: Strimple, Harrell L. 6933
Indocrinidae, n. fam.
Permian, taxonomy: Strimple, Harrell L. 6840
Isoallagecrinus eaglei, n. sp.
Permian, Oklahoma, Osage County, Red Eagle Limestone: Strimple, Harrell L. 6933
Metaindocrinus, n. gen., n. sp.
Permian, Texas, Glass Mts., Word Formation: Strimple, Harrell L. 6840
Crust
Atlantic Ocean
Continental shelf, Nova Scotia, seismic studies, thickness, relief: Berger, Jon. 7041
Continental shelf, Nova Scotia, structure, gravity, seismic data: Keen, Charlotte. 6897
Costa Rica
Pacific slope, oceanic, incorporated into continental: Weyl, Richard. 7161
Exploration
Deep drilling, land: Simmons, Gene. 6706
Genesis
Geochronology, continental development, isotopic data: Wasserburg, G. J. 6837
Oregon
Structure, southwestern, gravity data: Blank, H. Richard, Jr. 7115
Structure
Arctic Ocean, Beaufort Sea, seismic data: Milne, A. R. 7093
Continents, low-velocity zone, new evidence: Mueller, Stephen. 6741
Continents, low-velocity zone, wave propagation analysis: Landisman, Mark. 6742

Crust
Structure
Distortion systems, rules for continental drift: Wilson, J. T. 7091
Mississippi, southern, seismic data: Warren, David H. 6703
PP-wave analysis: Wu, Francis T. 7095
United States, western, seismic data, Salmon nuclear event: Archambeau, C. B. 6711
Crystal chemistry
Al-bentonites
Interlayer structure, Wyoming: Brydon, J. E. 7006
Clay minerals
Illites, mixed-layer illite/montmorillonite, structural-compositional relations: Hower, John. 6989
Mica-type, weathering effect on structure: Guven, Necip. 7005
Cummingtonite
Mg, Fe distributions over M_1-M_4 cation sites: Fischer, Karl B. 7003
General
Laboratory, mineralogy, dry synthesis, K(Cl, Br): Bodine, Marc W., Jr. 6690
Principles, mineralogy laboratory, Harpur College, N. Y.: Roberson, Herman E. 6689
Inesite
Formula, from infrared absorption spectra and X-ray data: Ryall, William R. 6998
Rock-forming silicates
Iron, location in structure, optical absorption spectra: White, William B. 6999
Crystal structure
Binnite
Refinement, comparison with tetrahedrite: Wuensch, B. J. 6700
Cummingtonite
Refinement: Fischer, Karl B. 7003
Sulvanite
Refinement: Trojer, Felix J. 7037
Tetrahedrite
Compared with binnite: Wuensch, B. J. 6700
Deformation
Compression
Stress, vertical shear component, weight of overburden: Howard, J. H. 6790
Elastic strain
Granitic rocks, in-situ measurement, Colorado, Nevada: Carroll, Roderick D. 7103
Experimental studies
Granite, relation of physical behavior to deformation and failure: Nichols, Thomas C., Jr. 7104
Devonian
California
Panamint Range, conodonts, Lost Burro Formation: Youngquist, Walter. 6969
Canada
Western, Gastropoda, *Orecopia*, late Frasnian age: Pedder, A. E. H. 6884
General
Stromatoporoidea, microstructures, taxonomy: Stearn, Colin W. 6885
Devonian
Indiana
Logansport area, Miami Bend Formation, Brachiopoda, correlation: Cooper, G. Arthur. 7144
Nevada
Roberts Mountains, Brachiopoda, Denay Limestone: Johnson, J. G. 6869
North America
Western, Gastropoda, Upper, *Orecopia*, distribution, review: Pedder, A. E. H. 6884
Quebec
Gaspe, Holland township, stratigraphy, structure: Brummer, J. J. 6797
Mount Vallieres-de-Saint Real map-area, stratigraphy, igneous rocks: Robert, Jean-Louis. 6694
Saskatchewan
Esterhazy, Prairie Evaporite: Clark, A. R. 6854
Diagenesis
Pyritization
Fossils, oolites: Kalliokoski, J. 7130
Diatomite
Alabama
Waterloo district, occurrence: Clarke, Otis M., Jr. 6983
Differential thermal analysis
Data
Al-bentonites, Wyoming: Brydon, J. E. 7006
Coconinoite, Arizona and Utah, new mineral: Young, E. J. 6939
Dominican Republic
Hydrogeology
Valley of Azua, Pleistocene Recent aquifer Gilboa (Greenberg), Y. 6757
Structural geology
Valley of Azua: Gilboa (Greenberg), Y. 6757
Earth
Composition
Elemental abundances, primordial, model: Ringwood, A. E. 6928
Relation to bronzite chondrites: Mason, Brian H. 7046
Elasticity
Free oscillations, Alaskan earthquake, 1964: Nowroozi, Ali Asghar. 6660
Equilibrium configurations
Elastic model: Durney, B. 6905
Interior
Mechanical properties, evidence, review: MacDonald, Gordon J. F. 6836
Seismological information, instrumentation advances: Press, Frank. 6930
Thermal structure, upper mantle convection, mechanical instability: Elsasser, Walter M. 6834
Origin
Elemental abundances, primordial, model: Ringwood, A. E. 6928
Physical properties
Mechanical and thermal changes, research, advances: Hurley, P. M. 6842

Earth
Temperature
Heat flow measurements, oceanic and continental methods: Birch, Francis. 6835
Earth tides
General
Textbook: Melchior, Paul. 7078
Earthquakes
Alaska
1964, Prince William Sound, U.S. Coast and Geodetic Survey studies: Wood, Fergus J. 7160
March 28, 1964, ocean tide loads, triggering effect: Berg, Eduard. 6864
California
June 27–29, 1966, Parkfield, damage: Steinbrugge, Karl V. 7069
June 27–29, 1966, Parkfield, motion, high acceleration: Cloud, William K. 7071
June 27–29, 1966, Parkfield, portable seismic staion data: Pakiser, L. C. 7029
June 27–29, 1966, Parkfield, pre- and post-earthquake fault slippage: Allen, Clarence R. 6949
June 27–29, 1966, Parkfield, seismic data, fault plane solution: McEvilly, T. V. 7061
November 16, 1964, Corralitos area, aftershock sequence, analysis: McEvilly, Thomas V. 7094
Detection
Advances, instrumentaion, interpretation, review: Press, Frank. 6930
Effects
Free oscillations, Alaskan earthquake, 1964: Nowroozi, Ali Asghar. 6660
Hawaii
1964, U.S. Geol. Survey Volcano Observatory, summary: Koyanagi, Robert Y. 7117
Nevada
Microseisms, portable seismograph observation: Oliver, Jack. 6955
Prediction
Model, probability, California: Epstein, B. 7164
Ecology
Analysis
Environmental stability and life, ocean atmosphere interaction: Weyl, Peter K. 6821
Changes
Evolutionary adaptation, principles: Williams, George C. 7135
Foraminifera
Lagoonal, Prince Edward Island, Tracadie Bay: Bartlett, G. A. 6798
Marine, Veracruz reefs, Mexico, biofacies: Lidz, Louis. 6778
Mollusca
Marine, near-shore, Pacific Ocean, northeastern: Addicott, W. O. 6644
Prince Edward Island
Lagoonal, Tracadie Bay, foraminifera : Bartlett, G. A. 6798
Ecology
Utah
Lacustrine, Great Salt Lake: Cohenour, Robert E. 6917
Economic geology
Methods
Estimating chromite grade: Jackson, Everett D. 6765
Resources
Petroleum, nature and occurrence, genesis: Hedberg, Hollis D. 7200
Education
Curricula
Geological profession, course recommended: Youngquist, Walter. 6687
General
Curricula, concept oriented, teacher and pre-professional preparation: Roy, Chalmer J. 7143
Curricula, New York State University, New Paltz College, earth science teachers, core course: Connally, G. Gordon. 7141
Earth science, teachers, ESCP survey, results: Shea, James H. 6688
Materials, departmental geological libraries, value: Paull, Richard A. 7140
Objectives, field geology program, high school students: O'Brien, Neal R. 7142
Uniformitarian doctrine, misrepresentation: Valentine, James W. 7139
Geomorphology
Methods, high-school level, stereograms, Illinois: Mueller, Bruce E. 6692
Marine geology
Reading course, selected references: Schubel, J. R. 7138
Mineralogy
Crystal chemistry, principles, experiments, laboratory, dry synthesis: Bodine, Marc W., Jr. 6690
Crystal chemistry, principles, laboratory, Harpur College, N. Y.: Roberson, Herman E. 6689
Objectives
Geology teaching, philosophy, guidelines: Ellison, Samuel P., Jr. 6686
Elastic properties
Al_2O_3
Experimental studies: Anderson, Orson L. 7059
Feldspar
Compressional wave velocities: Christensen, Nikolas I. 6819
Granitic rocks
In-situ measurement, Colorado and Nevada: Carroll, Roderick D. 7103
Limestone
Elastic waves, velocity: Wang, Chi-Yuen. 6903
Marble
Elastic waves, velocity: Wang, Chi-Yuen. 6903
Metamorphic rocks
Elastic waves, shear, velocity: Christensen, Nikolas I. 6906

Elastic properties
MgO
Experimental studies: Anderson, Orson L. 7059
Salt
Determination, in situ, 3-D velocity logs: Christensen, Dean M. 6923
Electrical methods
Interpretation
Resistivity, numerical analysis: Bukhari, S. A. 6810
Techniques
Evaporite exploration: Alger, R. P. 6848
Radio echo, airborne, glacier depth-sounding: Evans, S. 6865
Salt exploration, brine wells, geophysical logging: Bird, James M. 6893
Electrical surveys
Greenland
Ice cap, radio-echo sounding: Evans, S. 6865
Northwest Territories
Ellesmere and Axel Heiberg Islands, glaciers, radio-echo sounding: Evans, S. 6865
Elements
Analysis
Chemical methods, aluminum, calcium, gold, radon-radium, silver, strontium-barium: Kolthoff, I. M. 6981
Engineering geology
Applications
Coastal environment, littoral drift determination, heavy mineral analysis, tracer methods: Johnson, J. W. 7201
Earthquakes
California, Parkfield, 1966, building damage: Steinbrugge, Karl V. 7069
California, San Francisco, Wells Fargo Building, structural-dynamic analysis: Medearis, Kenneth. 7057
Foundations
Kentucky, limestone caverns, Oak Grove quadrangle: Klemic, Harry. 7137
Gas storage
Saskatchewan, Prairie Evaporite Formation: Allan, M. H. 6747
General
United States, activities 1965: Proctor, Paul D. 7189
Highways
Connecticut, metamorphic rocks, slope design: Siebert, H. 7191
Materials, properties
Granitic rocks, elastic constants, in-situ measurements: Carroll, Roderick D. 7103
Nuclear explosions
Nevada Test Site, lava tunnels and collapse cavities, seismic survey: Watkins, Joel S. 7052
Surface displacements, calculation: Bycroft, G. N. 7064
Rock mechanics
Coal fields, fracture distribution, joint diagrams, evaluation: Kirchmayer, Martin. 6961
Engineering geology
Rock mechanics
Hydraulic fracturing, preferred orientation, laboratory definition: Pegler, A. V. 6894
Ohio, Painesville area, salt mining: Emery, C. L. 6750
Photoelastic measurement, stress and strain: Roberts, Albert. 6963
Photoelastic measurement, stress and strain, disc technique: Heidecker, E. 6964
Potash, deformation measurements in mines: Baar, C. A. 6746
Salt, continuum theory, rock-salt structures, model: Serata, Shosei. 6745
Salt, hydraulic fracturing, effect of geology: Jacoby, Charles H. 6744
Salt, mine design, Ohio: Smith, John D. 6892
Salt, pillar movement, measurement: Peyfuss, Kurt F. 6749
Salt, spherical cavities, pressure-temperature effect, experimental: Nowotny, Ben. 6748
Silver Plume Granite, Colorado, relation to structures and application: Nichols, Thomas C., Jr. 7104
Shorelines
Littoral drift determination, heavy mineral analysis, tracer methods: Johnson, J. W. 7201
Slope stability
Florida, phosphate mining, open pit: Gardner, Charles H. 7128
Soil:
Mechanics, textbook: Wu, Tien Hsing. 6871
Residual shear strength, control by mineralogy, experimental tests: Kenney, T. C. 7154
Textbooks
Soil mechanics: Wu, Tien Hsing. 6871
Waste disposal
Nuclear rubble chimneys, model studies: Korver, John A. 6881
Radioactive solids, salt vault, demonstration plans, Kansas, Lyons mine: Empson, F. M. 6696
Erosion
Soils
California, wildfire temperature effects: Debano, L. F. 7025
Utah
Southwestern, denudation rates: Eardley, A. J. 6959
Estuaries
Sedimentation
Phosphate: McConnell, Duncan. 7163
Evaporites
Arizona
Holbrook basin, Permian, Supai Formation, genesis: Peirce, H. Wesley. 6915
California
Geochemistry, Kramer lake beds, borax, ulexite, colemanite zonation: Bowser, C. J. 6853
Searles Valley, Pleistocene, Recent, lake beds, depositional features: Smith, George I. 6668

Evaporites
Experimental studies
Salt, crystals, gross imperfections, habit modification: Shuman, A. Cornwell. 6922
Exploration
Electrical logging, methods: Alger, R. P. 6848
General
Symposium, Northern Ohio Geological Society: Rau, Jon L. 6924
Genesis
Geochemical observations: Adams, Samuel S. 7179
Geochemistry
Gypsum, anhydrite, equilibrium, H_2O activity: Hardie, L. A. 6681
Salt, rock thickness, bromide ratio, theory of profiles: Holser, William T. 6920
Trona deposition, brine conditions, experimental saturations: Eugster, H. P. 6680
New Mexico
Geochemistry, genesis: Adams, Samuel S. 7179
Texas
Geochemistry, genesis: Adams, Samuel S. 7179
Utah
Great Salt Lake area, geochemistry, hydrogeology, environmental factors: Cohenour, Robert E. 6917
Moab region, Hermosa Formation, Paradox halite beds, bromine distribution: Raup, Omer B. 6761
Wyoming
Southwestern, Green River Formation, trona beds, paleolimnology: Bradley, W. H. 6679
Evolution
Aves
General, geographic aspects: Amadon, Dean. 6876
Concepts
Adaptation and natural selection, principles, application: Williams, George C. 7135
Crinoidea
Allagecrinidae, Devonian–Permian: Strimple, Harrell L. 6933
Foraminifera
Fusulina, Pennsylvanian, United States, southwestern, septal folding: Elias, Maxim K. 6839
Gymnosperms
Pteridosperms, Permian, Texas: Mamay, Sergius H. 6677
Man, fossil
Transitions, absolute dating: Oakley, Kenneth P. 6730
Processes
Adaptation and natural selection, principles, application: Williams, George C. 7135
Reptilia
Cretaceous, aquatic adaptation, United States, western, mosasaur: Russell, Dale Alan. 6661
Faults
Block
Utah, Markagunt Plateau, Tertiary history: Anderson, John Jerome. 6683
Experimental studies
Granitic terrane, displacements due to movement or energy release: Lee, Fitzhugh T. 7202
Overthrusting, mechanism, gypsum dehydration: Heard, Hugh C. 7065
Grabens
Dominican Republic, Valley of Azua: Gilboa (Greenberg), Y. 6757
Horsts
Oklahoma, Tishomingo: Harlton, Bruce H. 6806
Normal
Georgia, Thomas County, Ochlockonee fault: Sever, Charles W. 7100
Overthrust
California, Santa Monica Mts.: Campbell, R. H. 7099
Wyoming, Wind River Mountains: Berg, Robert E. 6789
Shear zones
Colorado, Wet Mountains, Ilse fault zone: Singewald, Q. D. 7102
Strike-slip
California, Cholame Valley region, San Andreas fault: Dickinson, William R. 7063
California, Corralitos area, San Andreas, motion, November 1964: McEvilly, Thomas V. 7094
California, Parkfield area, San Andreas, slippage 1966: Allen, Clarence R. 6949
California, Parkfield area, San Andreas, slippage 1966: Pakiser, L. C. 7029
Systems
Canada, Maritime Provinces, Cabot fault zone: Cameron, H. L. 7042
Kentucky, Richmond area, northwest trending: Simmons, George C. 7101
Oklahoma, Arbuckle Mountains faults, Ouachita faults, relations: Harlton, Bruce H. 6806
Tennessee, eastern, Dumplin Valley, fault zone: Hatcher, Robert Dean, Jr. 6685
Florida
Absolute age
C-14, Florida State Univ. laboratory, list: Stipp, J. J. 6986
Economic geology
Phosphate, resources, land pebble deposits: Houston, Wesley M. 7178
Engineering geology
Slope stability, open pit mining: Gardner, Charles H. 7128
Geochemistry
Northwestern, humate, metal sorption: Swanson, Vernon E. 7196
Hydrogeology
Ground water, problems in pit mining: Vernon, Robert O. 7174
Ocala limestone, aquifer, movement measurement, C-14: Rubin, Meyer. 6716

Florida
Mineralogy
Carbonate minerals, thermogravimetry with X-ray diffraction: McCaleb, Stanley B. 7125
Fluid inclusions
Living bacteria
Paleozoic, rock salt crystals: Dombrowski, H. J. 6918
Folds
General
Quebec, Gatineau–Petite Nation interfluve, stages: Dimroth, Erich. 7122
Foraminifera
Age determination
C–14, contamination sources, experimental studies: Olsson, Ingrid U. 6735
Cibicides compressus Olsson
Nomenclature, renamed *Gavellinella olssoni*: Steineck, P. L. 6823
Cretaceous
Alaska, northern, microfaunal zones, correlation: Bergquist, Harlan R. 6824
Ecology
Mexico, Veracruz reefs: Lidz, Louis. 6778
Fusulina insolita
Pennsylvanian, U.S., southwestern, septal folding, identification, evolution: Elias, Maxim K. 6839
Fusulinidae
Pennsylvanian–Permian, Nevada, Bird Spring Group, Arrow Canyon: Cassity, P. E. 6967
Gavellinella olssoni
Nomenclature, new name for *Cibicides compressus* Olsson: Steineck, P. L. 6823
General
Staining technique, planktonic specimens: Berger, W. H. 6863
Planktonic
Technique, sorting shelled: Boltovshoy, Esteban. 6886
Recent
Prince Edward Island, Tracadie Bay, ecology: Bartlet, G. A. 6798
Fractures
Experimental studies
Colorado, Straight Creek area, Silver Plume Granite, cause: Lee, Fitzhugh T. 7202
Joints
California, Calaveras County, Wool Hollow Cave, slippage with earth tides: Davis, S. N. 7055
Patterns
Joint diagrams, appraisal, informative value in coal fields: Kirchmayer, Martin. 6961
Northwest Territories, Greenland, continental drift: Hilgenberg, Ott Christoph. 6667
Gas, natural
Gulf Coastal Plain
Salt domes, review: Halbouty, Michael T. 6878
Kentucky
Martin quadrangle, resources: Rice, Charles L. 7136
Gas, natural
Kentucky
Milo and Webb quadrangles, resources: Jenkins, Evan C. 7149
United States
Analyses 1964: Moore, B. J. 7192
Gastropoda
Oliva
Taxonomy, lectotypes of *Voluta* Linnaeus species: Olsson, Axel A. 6940
Orecopia
Devonian, Upper, North America, Europe, distribution, review: Pedder, A. E. H. 6884
Orecopia cotei, n. sp.
Devonian, Canada, western, late Frasnian age: Pedder, A. E. H. 6884
Gems
Opal
Mexico, San Luis Potosi, hyalite, iris-effect: Sinkankas, John. 7197
General
Geological libraries
University departmental facilities, educational value: Paull, Richard A. 7140
Massachusetts Institute of Technology
International Conference, 1964, Earth science, advances: Hurley, P. M. 6842
Philosophy
Curricula, earth science teachers, New Paltz College, core course: Connally, G. Gordon. 7141
Geologic principles, education, field approach, high school students: O'Brien, Neal R. 7142
Geology teaching, guidelines: Ellison, Samuel P., Jr. 6686
Uniformitarian doctrine, misrepresentation: Valentine, James W. 7139
Practice
Earth science, teachers, ESCP survey, results: Shea, James H. 6688
Earth science teaching, concept oriented, curricula and preparation: Roy, Chalmer J. 7143
Education, course, geological profession, need: Youngquist, Walter. 6687
Textbooks
Physical geology: Rogers, John J. W. 6938
Geochemical prospecting
General
United States, activities 1965: Bloom, Harold. 7188
Potash
Canada, eastern, Cumberland basin evaporites, bromide method: Baar, C. A. 6849
Uranium
General: Michelson, Robert A. 7158
Geochemical surveys
Nevada
Gold, Cortez district, anomaly: Erickson, R. L. 6896

Geochemistry
Abundance of elements
Crust, barium and strontium: Turekian, Karl K. 7021
Crust, calcium cf. barium and strontium: Turekian, Karl K. 6978
Earth, primordial: Ringwood, A. E. 6928
Evaporites
Salt, rock thickness, bromide ratio, theory of profiles: Holser, William T. 6920
Exchange capacity
Wairakite, analcime, synthetic wairakite, Ca- and Sr-analcime: Ames, L. L., Jr. 7033
Ground water
Carbonate solution, effect, C-14 dating: Pearson, F. J., Jr. 6737
Methods
Analysis, aluminum, calcium, gold, radon-radium, silver, strontium-barium: Kolthoff, I. M. 6981
Natural waters
Sedimentary basins, calcium and bromide content: Anderson, Raymond J. 6825
Processes
Diffusion: Bottinga, Y. 7036
Diffusion: Field, Cyrus W. 7184
Isotope fractionation, lead: Heyl, A. V. 7121
Silicate hydrolysis, saline waters, closed basins, United States, western: Jones, Blair F. 6669
Weathering, rocks, minerals, raw materials, source: Keller, W. D. 6691
Solubility
Iron, manganese, pH-control: Bartholome, Paul. 7185
Muscovite, potassium removal: Reed, M. G. 7079
Orpiment, Na_2S-H_2O solution: Weissberg, B. G. 6862
Sulfur, mafic magma: Skinner, Brian J. 6770
Water
Popular account: Leopold, Luna B. 6702
Geochronology
Tree rings
Application, C-14 dating: Bannister, Bryant. 6738
Geodesy
General
Geophysical data correlation, gravimetrically unsurveyed area: Durbin, William P., Jr. 7075
Geoid
Form, analysis, gravity data, statistical methods and model: Kaula, W. M. 7212
Isostatic reduction of data, indirect effect, calculation: Lambert, Walter D. 7074
Partial potential anomalies, determination: deGraaff-Hunter, J. 7073
Undulations, calculations from free-air anomalies, global map: Kivioja, Lassi A. 7076
Geologic thermometry
Kimberlite
Pyroxene pairs, equilibrium temperatures: Davis, B. T. C. 6900
Methods
System Fe-Zn-S: Barton, Paul B., Jr. 7183
Orpiment
Solubility, temperature change effect: Weissberg, B. G. 6862
Geological exploration
Methods
Continental shelf, research, interagency conference, proceedings: Taney, Norman E. 6646
Map construction, contact drawing, structure contours based on isopachs: Ferguson, C C. 6984
United States, deep drilling, Upper Mantle Committee: Simmons, Gene. 6706
United States
Activities 1965: Patrick, Joseph L. 7190
Geomorphology
Environment
Glacial features, till-stone orientation, early theory: Elson, John A. 6811
Lacustrine, Arctic, permafrost distribution: Johnston, G. H. 7048
Erosion
Puerto Rico, Utuado batholith area, differential, causes: Birot, P. 6812
Fluvial features
Alluvial fan, Rio Nigua, Salinas area: McClymonds, N. E. 7088
Drainage changes, karst valley, Indiana, Monroe County, Richland Creek basin: Powell, Richard L. 7020
Rivers, deposition and erosion, popular account: Leopold, Luna B. 6702
Sediment transport, dominant discharge defined: Benson, M. A. 6962
Sedimentation, Illinois, Ohio River, flood plain: Nunnally, Nelson Rudolph. 6682
Glacial features
Moraines, Yukon, central, ice advances, correlation: Bostock, H. S. 6833
Lacustrine features
Terminology, water and water use, glossary: Veatch, J. O. 6877
Landform evolution
Valley, Atlantic Coastal Plain, southeastern: Colquhoun, D. J. 6640
Mass movement
Alpine mudflows, Colorado: Curry, Robert R. 7067
Periglacial features
Soli Fluction, Colorado, Niwot Ridge, stone-bank terraces: Benedict, James B. 7098
Quantitative geomorphology
Fluvial features, relation to hydrology, Puerto Rico, Rio Grande de Manati: Lewis, Laurence A. 6768
Streams, sediment transport, dominant discharge, percentage duration: Benson, M. A. 6962

Geomorphology
Shore features
Sedimentation, Texas, hurricane effects: Hayes, Miles Oren. 6655
Solution features
Bedding plane anastomoses, phreatic origin, cavern extension: Ewers, Ralph O. 7030
Karst, bauxite deposits: Clarke, Otis M., Jr. 7162
Karst valley, Indiana, Monroe County, Richland Creek basin: Powell, Richard L. 7020
Karst, Wyoming, Teton Mts., South Darby Canyon: Stellmack, John A. 7053
Terraces
Barbados, reef: Russell, R. J. 6813
Colorado, Boulder County, Niwot Ridge, stone bank, age: Benedict, James B. 7098
Geophysical methods
General
Advances 1965, United States: Heinrichs, Walter E., Jr. 7187
Georgia
Hydrogeology
Glynn County, ground-water levels, fluctuations, tidal: Gregg, D. O. 7207
Thomas County, Eocene and Recent aquifers: Sever, C. W. 6791
Sedimentary petrology
Soils, Cecil and Hayesville series, similarities: Gibbs, J. A. 7147
Structural geology
Thomas County, faults: Sever, C. W. 6791
Thomas County, Miocene deformation and fault: Sever, Charles W. 7100
Germanium
Geochemistry
Willemite, New Mexico, Utah: Scheffer, Herman W. 6861
Glaciation
Correlation
Limits of advances, Yukon, central: Bostock, H. S. 6833
Ice movemeent
Erosion of landscapes, popular account: Leopold, Luna B. 6702
Glaciers
Ice
Equilibrium dimensions, sheets, basal water layer effect: Weertman, J. 6709
Glossaries
Hydrogeology
Water and water use terminology: Veatch, J. O. 6877
Gold
Analysis
Chemical methods, separation, determination procedures, fire assay: Herz, Nathaniel. 6977
General
Occurrence, recovery, properties, analysis: Herz, Nathaniel. 6977
Gold
Nevada
Cortez district, geochemical anomaly: Erickson, R. L. 6896
Exploration: Hardie, Byron S. 7170
Properties
Physical and chemical: Herz, Nathaniel. 6977
Graptolithina
Ordovician
North America, Great Britain, correlation: Berry, William B. N. 6776
Gravel
Kentucky
Milo and Webb quadrangles, resources: Jenkins, Evan C. 7149
Gravity field, Earth
General
Unsurveyed areas, symposium: Orlin, Hyman. 7224
Networks
Extension to unsurveyed areas: Heiskanen, W. A. 7072
Extension to unsurveyed areas: Rapp, Richard. 7195
World, coverage through 1964: Uotila, U. A. 7194
World, measurements, progress since 1962: Szabo, Bela. 7220
Observations
Canada, summary of mapping program: Innes, M. J. B. 7221
External field, computation methods: Moritz, Helmut. 7218
External field, computation techniques: Mueller, Ivan I. 7217
External field, normal, computation, formulas: Caputo, Michele. 7216
Pacific Ocean, surface ship: Caputo, Michele. 7222
Potential field, satellite observations: Arnold, K. 7219
Gravity methods
Airborne
Instruments, advances 1963–64, U.S. Air Force: Thompson, Lloyd G. D. 7223
Instruments
Advances 1963–64, airborne, U.S. Air Force: Thompson, Lloyd G. D. 7223
Shipborne, error correction: Talwani, Manik. 7214
Interpretation
Buried topography, vertical density contrast, anomalies: Haye, Edward F. 7031
Model, Puerto Rico Trench, Mid-Atlantic Rise, tectonics: Morgan, W. Jason. 6908
Model, Puerto Rico Trench, Mid-Atlantic Rise, tectonics: Talwani, Manik. 6714
Techniques
Anomaly prediction, unsurveyed gaps: Groten, Erwin. 7213
Geophysical, gravity net, extension to unsurveyed areas: Heiskanen, W. A. 7072
Gravity values, prediction, restricted and unsurveyed areas: Woollard, G. P. 7215

Gravity methods
Techniques
Isostatic reduction of data, indirect effect, calculation: Lambert, Walter D. 7074
Partial potential anomalies, determination: deGraaff-Hunter, J. 7073
Shipborne measurements, instrumental errors: Talwani, Manik. 7214
Statistical, geoid form: Kaula, W. M. 7212
Statistical, gravity nets, extension to unsurveyed areas: Rapp, Richard. 7195
Statistical, linear regression prediction, mean anomalies: Groten, Erwin. 7211
Topographic effect, free-air anomalies, and geoid undulations, calculation: Kivioja, Lassi A. 7076
Gravity surveys
Atlantic Ocean
Continental shelf, Nova Scotia, crust, mantle structure: Keen, Charlotte. 6897
Colorado
Mineral Belt: Case, J. E. 7172
Uncompahgre Plateau, anomalies, correlation with geology: Case, James E. 6780
Gulf of California
General: Caputo, Michele. 7222
Oregon
Southwestern, crustal structure: Blank, H. Richard, Jr. 7115
Pacific Ocean
California borderland: Caputo, Michele. 7222
Utah
Uncompahgre Plateau, anomalies, correlation with geology: Case, James E. 6780
Wyoming
Wind River Basin: Case, J. E. 7116
Wind River Mountains: Berg, Robert E. 6789
Great Lakes region
Absolute age
Lake Erie area, interstadial samples, C-14: Dreimanis, Aleksis. 6720
Glacial geology
Lake Erie area, Port Talbot Interstadial, reevaluation: Dreimanis, Aleksis. 6720
Greenland
Absolute age
C-14, Copenhagen National Museum laboratory, list: Tauber, Henrik. 7012
C-14, Isotopes, Inc. laboratory, list: Trautman, Milton A. 6992
Icecap, Tuto Tunnel, C-14: Oeschger, Hans. 6754
Mesters Vig, Skeldal area, shells, peat: Lasca, Norman Paul, Jr. 6657
Economic geology
Uranium, Ilimaussaq intrusion: Sorensen, Henning. 6645
Geophysical surveys
Ice sheet, radio echo, thickness: Evans, S. 6865
Glacial geology
Ice cap, thickness, radio echo survey: Evans, S. 6865
Greenland
Glacial geology
Mesters Vig, Skeldal area, glaciation, Pleistocene, retreat, chronology: Lasca, Norman Paul, Jr. 6657
Mineralogy
Epididymite, Narssarssuk and Ilimaussaq: Petersen, Ole V. 7000
Petrology
Disko, xenoliths in basalt: Melson, William G. 6822
Ilimaussaq intrusion: Sorensen, Henning. 6645
Structural geology
Fractures, lineaments, Kennedy Channel shear rotation, continental drift: Hilgenberg, Ott Christoph. 6667
Ground water
Alberta
Movement, Ghostpine Creek valley, prairie environment, mapping: Toth, J. 7026
Arizona
Model studies, Santa Cruz River basin, recharge: Matlock, W. G. 7208
Movement, Tucson Basin, C-14 dating: Bennett, Richmond. 6717
Atlantic Coastal Plain
Salt-water intrusion, northern: Upson, Joseph E. 7089
British Columbia
Exploration, Fraser Valley, Aldergrove test hole: Halstead, E. C. 6800
Dominican Republic
Resources, Valley of Azua, Pleistocene-Recent aquifer: Gilboa (Greenberg), Y. 6757
Florida
Movement, Ocala limestone, aquifer, C-14 measurement: Rubin, Meyer. 6716
Georgia
Levels, Glynn County, fluctuations, tidal: Gregg, D. O. 7207
Resources, Thomas County: Sever, C. W. 6791
Kentucky
Resources, Dublin quadrangle: Hansen, Arnold J., Jr. 7133
Resources, Fancy Farm quadrangle: Davis, R. W. 7155
Resources, Heath quadrangle: Lambert, T. W. 7156
Maryland
Resources, Delmarva Peninsula, aquifer recharge: Gardner, Richard A. 7127
Massachusetts
Basic data, Housatonic River basin, Berkshire County: Norvitch, Ralph F. 6827
Montana
Index map and bibliography of studies: Botz, Maxwell K. 6672
Nevada
Movement, White River area, regional interbasin system: Eakin, Thomas E. 6866

Ground water
North Carolina
Levels, salt-water intrusion, Lee Creek phosphate mine: Welby, Charles W. 7176
Ohio
Movement, Piketon area, electric-analog study: Norris, S. E. 7205
Puerto Rico
Resources, Salinas area, alluvial fan of Rio Nigua: McClymonds, N. E. 7088
Texas
Composition, Atascosa County, Carrizo Sand, carbonate, C-14 dating: Pearson, F. J., Jr. 6737
Levels, High Plains, southern, data: Gammon, Sam W. 6782
Vermont
Resources, Batten Kill, Walloomsac River, Hoosic River basins: Hodges, Arthur L., Jr. 6648
Wisconsin
Spring flow, La Crosse area, fluctuations, climatic variables: Curtis, Willie R. 6882
Guatemala
Absolute age
C-14, Gif-sur-Yvette laboratory, list: Coursaget, J. 6948
Geomorphology
Central, Highlands region, volcanic chain and plateau features: Weyl, Richard. 7068
Maps
Geomorphologic, central: Weyl, Richard. 7068
Volcanology
Central, Highlands region, Cenozoic, geologic features, geomorphology: Weyl, Richard. 7068
Gulf Coastal Plain
Economic geology
Mineral resources, salt dome related: Halbouty, Michael T. 6878
Paleontology
Bryozoa, lectotype designations: Greeley, Ronald. 6968
Structural geology
Salt domes, Louann salt: Halbouty, Michael T. 6878
Gulf of California
Sedimentary petrology
Sediments, diatomaceous, silica source: Calvert, S. E. 6913
Gymnosperms
Tertiary
Alaska, Cook Inlet region, floral correlation, time-stratigraphic units: Wolfe, Jack A. 6911
Tinsleya texana, n. gen., n. sp.
Permian, Texas, Baylor County, Lueders Limestone: Mamay, Sergius H. 6677
Gypsum
Virginia
Saltville area, occurrence, Maccrady Formation: Cooper, Byron N. 6759
Haiti
Sedimentary petrology
Northwest peninsula, coastal plain, marnolithic and alluvial soils: Pahaut, P. E. 6936
Halogens
Abundance
Meteorites, chondrites: Reed, George W., Jr. 6856
Hawaii
Earthquakes
1964, U.S. Geol. Survey Volcano Observatory, summary: Koyanagi, Robert Y. 7117
Geochemistry
Kilauea Volcano, magmatic gases, oxygen fugacities: Sato, Motoaki. 6781
Petrology
Alae lava lake, melt: Skinner, Brian J. 6770
Structural geology
Crustal subsidence: Moberly, R., Jr. 6943
Volcanology
Kilauea Volcano, magma, oxygen fugacities, differentiation: Sato, Motoaki. 6781
Heat flow
Conductivity
Rock, compact, pressure of saturating fluid, effects: Walsh, J. B. 6816
Measurement
Earth, oceanic and continental methods: Birch, Francis. 6835
Regional patterns
Differences, pressure of saturating fluid, effect: Walsh, J. B. 6816
Theory
Mantle, convection motions and orogeny, gradients: Elsasser, Walter M. 6834
Heavy minerals
California
Stanford University area, sandstones, Tertiary, assemblages: Tieh, Thomas Tapin. 6664
Methods
Separation and counting: Ramesam, V. 6971
Technique
Bromoform recovery: Turner, William M. 7086
Helium
United States
Resources, content in natural gas, 1964: Moore, B. J. 7192
Hydrogen
Isotopes
Tritium, tracer, experiments: Stewart, Gordon L. 6718
Hydrogeology
Automatic data processing
Water-quality data, Kansas: Morgan, C. O. 7206
Experimental studies
Flow rates in clay, Darcy's law in kaolinite, validity, new technique: Olsen, Harold W. 6868
Fluid flow, nuclear rubble chimneys, waste disposal: Korver, John A. 6881

Hydrogeology
Experimental studies
Ground-water recharge, effect of entrapped air: Bianchi, W. C. 6883
Exploration methods
Well logging, electrical: Carter, V. B. 7225
Florida
Ground water, problems in pit mining: Vernon, Robert O. 7174
Geochemistry
Carbonate content, effect, C-14 dating: Pearson, F. J., Jr. 6737
Closed basins, saline waters, evolution: Jones, Blair F. 6669
Water, natural, calcium and bromide content, sedimentary basins: Anderson, Raymond J. 6825
Ground-water contamination
Nevada, Sand Springs Range, Project Shoal nuclear explosion: Hazleton-Nuclear Science Corp. 6830
Ground-water movement
Aquifers, homogeneous anisotropic, drawdown around wells, solutions: Hantush, Mahdi S. 6867
Conductivity of clays, Darcy's law in kaolinite, validity: Olsen, Harold W. 6868
Experimental recharge, effect of entrapped air: Bianchi, W. C. 6883
Measurement, C-14: Rubin, Meyer. 6716
Prairie environment, flow systems, reconnaissance, mapping: Toth, J. 7026
Tritium activity: Stewart, Gordon L. 6718
Hydrodynamics
Moisture movement, frozen soils, Fairbanks silt, Alaska: Hoekstra, Pieter. 6941
Mathematical models
Ground-water evaporation, soils, losses, theoretical prediction: Liakopoulos, Aristides C. 6880
Methods
Flow rates in clay, Darcy's law in kaolinite, validity, new technique: Olsen, Harold W. 6868
Ground-water evaporation, soils, losses, theoretical prediction: Liakopoulos, Aristides C. 6880
Resource development
Illinois, Chicago, geologic aspects: Hackett, James E. 7173
Popular account, picture essays: Leopold, Luna B. 6702
Idaho
Economic geology
Lead, Coeur d'Alene, resources, review: Beall, John V. 7169
Silver, Coeur d'Alene, resources, review: Beall, John V. 7169
Zinc, Coeur d'Alene, resources, review: Beall, John V. 7169
Mineralogy
Plagioclase, composition, variations, Columbia River basalt: Hoffer, Jerry M. 7002
Idaho
Petrology
Columbia River basalt: Hoffer, Jerry M. 7002
Igneous rocks
Basalt
Composition and texture, plagioclase in phenocrysts and groundmass: Hoffer, Jerry M. 7002
Crystallization of plagioclase phenocrysts: Bottinga, Y. 7036
Geochemistry, metallic iron origin, Greenland: Melson, William G. 6822
Geochemistry, tholeiite, genesis, lead isotope data: Tatsumoto, M. 6934
Sulfide liquid: Skinner, Brian J. 6770
Carbonatite
Genesis, system $CaO-SiO_2-CO_2-H_2O$, application: Wyllie, P. J. 6846
Composition
Central America, West Indies, plutonic, volcanic source: Weyl, Richard. 6767
Standard rocks, G-1 and W-1, analytical development, cf. German standard: Schindler, Rolf. 6675
Differentiation
Basalt, oceanic: Tatsumoto, M. 6934
General
Absolute age, crustal development: Wasserburg, G. J. 6837
Granite
Physical properties, conductivity, experimental studies: Walsh, J. B. 6816
Granitization
Quebec, Gatineau-Petite Nation interfluve, stages: Dimroth, Erich. 7122
Mafic
Differentiation: Lindsley, D. H. 6652
Norite
General description, Ontario: Souch, B. E. 6773
Pegmatite
Composition and sequence, Colorado, Mount Rosa area: Gross, Eugene B. 6699
Plutonic
Geochemistry, absence of leucite: Scarfe, C. M. 6996
Rhyolite
Structure and thermal history, Nevada: Christiansen, Robert L. 6960
Ultramafic
Alteration, serpentinization, constant-volume process: Thayer, T. P. 6994
Classification, nickeliferous: Kilburn, L. C. 6636
Composition, K/Rb ratio, significance in mantle differentiation: Stueber, Alan M. 6974
Differentiation: Taylor, Hugh P., Jr. 6653
Differentiation, alpine types: Thayer, T. P. 6651
General description, Muskox intrusion: Irvine, T. N. 6649
Geochemistry, Stillwater Complex: Jackson, Everett D. 6765

Igneous rocks
Volcanics
General description, Costa Rica, Coastal Range, southern area: Henningsen, Dierk. 6666
General description, Guatemala, central, Highlands: Weyl, Richard. 7068
Petrology, Mexico, Revillagigedo archipelago, Isla San Benedicto: Richards, Adrian F. 7134

Illinois
General
Education, Harlem High School, Loves Park, stereograms, use: Mueller, Bruce E. 6692
Hydrogeology
Chicago, resources planning, geologic aspects: Hackett, James E. 7173
Paleontology
Ostracoda, Mississippian, Chester Series, *Polytylites*: McGuire, Odell S. 6887
Sedimentary petrology
Ohio River, flood plain, meander loop deposits: Nunnally, Nelson Rudolph. 6682

Inclusions
Salt crystals
Brine cavities, solid particles, effects, habit modification: Shuman, A. Cornwell. 6922

Indiana
Absolute age
C-14, Packard Instrument Company laboratory, list: Kowalski, Sandra J. 7016
Geomorphology
Monroe County, Richland Creek basin, karst valley: Powell, Richard L. 7020
Paleontology
Brachiopoda, Devonian, Miami Bend Formation, *Stringocephalus*: Cooper, G. Arthur. 7144
Stratigraphy
Devonian, Miami Bend Formation, correlation, brachiopods: Cooper, G. Arthur. 7144

Intrusions
Complex
Greenland, Ilimaussaq intrusion: Sorensen, Henning. 6645
Layered
Muskox intrusion: Irvine, T. N. 6649
Stillwater Complex: Jackson, Everett D. 6765
Plutons
United States, western, age, relation to orogeny: Ramspott, L. D. 6792
Structure
Nickeliferous, ultramafic: Kilburn, L. C. 6636
Ultramafic
Alpine types: Thayer, T. P. 6651

Invertebrata
Quaternary
California, Pleistocene, central, assemblages, paleoecology: Addicott, W. O. 6644

Iowa
Geochemistry
Dubuque area, Level Crevice Cave, Galena dolomite, solubility: Morehouse, David F. 7051

Iron
Geochemistry
Control by pH: Bartholome, Paul. 7185
Diagenetic pyritization: Kalliokoski, J. 7130
Experimental studies: Craig, J. R. 6638
Experimental studies: Kullerud, G. 6637
Muskox intrusion: Irvine, T. N. 6649
Ultramafic complexes, Alaska: Taylor, Hugh P., Jr. 6653
Missouri
Ore deposits, general: Snyder, Frank G. 6654

Isostasy
Equilibrium configurations
Elastic Earth model: Durney, B. 6905

Isotopes
Gold
List, half life: Herz, Nathaniel. 6977
Krypton
Estherville meteorite: Pepin, Robert O. 6904
Lead
Abundance, "frequently mixed" source, model study: Russell, R. D. 7077
Basalt, oceanic, ratios: Tatsumoto, M. 6934
Mississippi Valley type deposits: Heyl, A. V. 7121
Ore, Colorado: Delevaux, M. H. 7082
Whole-rock, mineral, ratios, Texas, Llano Uplift: Ulrych, T. J. 6818
Meteorites
Silver, lithium, anomalies, cf. terrestrial: Dews, Jon Robert. 6665
Oxygen
Sea water, enrichment by evaporation: Lloyd, R. M. 6857
Radon
Atmosphere, abundance, diurnal oscillations: Staley, D. O. 6727
Residual soils
Distribution, uranium, thorium, California: Hansen, Richard Otto. 6684
Silver
Meteorites, Canyon Diablo: Dews, John R. 6817
Sulfur
Meteorites, differentiation: Kaplan, I. R. 6847
Ores, ratios: Field, Cyrus W. 7184
Thoron
Atmosphere, abundance, diurnal oscillations: Staley, D. O. 6727
Tritium
Hydrology, significance: Libby, Willard F. 6902
Tracer experiments, ground water: Stewart, Gordon L. 6718
Uranium
Ratios, natural variation, Pleistocene, dating potential: Thurber, David Lawerence. 6769
Xenon
Estherville meteorite: Pepin, Robert O. 6904

Jamaica
Absolute age
C-14, Instituto Venezolano Inv. Cientificas laboratory, list: Tamers, M. A. 7011
Economic geology
Bauxite, sinkhole deposits: Clarke, Otis M., Jr. 7162
Geomorphology
Above Rocks batholith area, differential erosion, causes: Birot, P. 6812
Weathering
Above Rocks batholith area, differential, causes: Birot, P. 6812

Jurassic
North America
Mollusca, Middle, cf. Europe, Morocco, paleogeography: Mongin, Denise. 6771
Utah
Sevier Valley, Arapien Formation, bedded halite: Pratt, A. R. 6760
Wyoming
Johnson County, Ostracoda, Morrison Formation, *Theriosynoecum* type: Branson, Carl C. 6838

Kansas
Absolute age
C-14, Gakushuin Univ. laboratory, list: Kigoshi, Kunihiko. 6946
Engineering geology
Waste disposal, Lyons salt mine, radioactive solids: Empson, F. M. 6696
Geochemistry
Wellington Formation, Hutchinson salt, bromide profile: Holser, William T. 6920
Geomorphology
Northeastern, cave, manmade, speleothem growth: Siegel, Frederic R. 7159
Hydrogeology
Ground-water program, water quality data, computer processing: Morgan, C. O. 7206

Kentucky
Economic geology
Coal, petroleum, natural gas, Martin quadrangle, resources: Rice, Charles L. 7136
Coal, sand, natural gas, Milo and Webb quadrangles, resources: Jenkins, Evan C. 7149
Mineral resources, evaluation, geologic mapping program: McGrain, Preston. 7175
Mineral resources, Little Cypress quadrangle: Amos, Dewey H. 7151
Engineering geology
Foundations and drainage systems, Oak Grove quadrangle: Klemic, Harry. 7137
Hydrogeology
Dublin quadrangle, Eocene sand aquifer: Hansen, Arnold J., Jr. 7133
Fancy Farm quadrangle, Eocene sand aquifer: Davis, R. W. 7155
Heath quadrangle, Cretaceous and Tertiary aquifers: Lambert, T. W. 7156

Kentucky
Maps
Geologic, Little Cypress quadrangle: Amos, Dewey H. 7151
Geologic, Martin quadrangle: Rice, Charles L. 7136
Geologic, Milo and Webb quadrangles: Jenkins, Evan C. 7149
Geologic, Oak Grove quadrangle: Klemic, Harry. 7137
Ground water, Dublin quadrangle: Hansen, Arnold J., Jr. 7133
Ground water, Fancy Farm quadrangle: Davis, R. W. 7155
Ground water, Heath quadrangle: Lambert, T. W. 7156
Paleontology
Ostracoda, Mississippian, Chester Series, *Polytylites*: McGuire, Odell S. 6887
Stratigraphy
Carboniferous and Quaternary, Milo and Webb quadrangles, section: Jenkins, Evan C. 7149
Carboniferous, Cretaceous, Cenozoic, Little Cypress quadrangle, sections: Amos, Dewey H. 7151
Mississippian and Quaternary, Oak Grove quadrangle, section: Klemic, Harry. 7137
Pennsylvanian and Quaternary, Martin quadrangle, section: Rice, Charles L. 7136
Structural geology
Richmond area, faults, movement periods: Simmons, George C. 7101

Lakes
Limnology
Glossary of terms: Veatch, J. O. 6877
Utah
Great Salt Lake, fluctuation, saline deposits: Cohenour, Robert E. 6917

Lakes, extinct
Colorado
Florissant Lake, paleoecology, limnology: McLeroy, Carol Ann. 6829
Wyoming
Gosiute Lake, Eocene, Green River Basin, evaporite deposition: Bradley, W. H. 6679

Laterites
Genesis
Karst, role: Clarke, Otis M., Jr. 7162

Lava
Structural features
Nevada, southern, rhyolite flow: Christiansen, Robert L. 6960
Temperature
Thermal history, Nevada, southern: Christiansen, Robert L. 6960

Lead
Idaho
Coeur d'Alene, resources, review: Beall, John V. 7169
Isotopes
Abundance, "frequently mixed" source, model study: Russell, R. D. 7077
Ratios, basalt, oceanic: Tatsumoto, M. 6934
Ratios, Mississippi Valley: Heyl, A. V. 7121

Lead
Isotopes
Ratios, ores, Colorado: Delevaux, M. H. 7082
Ratios, whole rock, mineral, Texas, Llano Uplift: Ulrych, T. J. 6818
Lineation
Statistical studies
Louisiana, salt dome alinements, model test: Harvey, J. R. 6916
Lithium
Isotopes
Li-7/Li-6, Bruderheim, Bjurbole chondrules, cf. granite G-1: Dews, Jon Robert. 6665
Louisiana
Absolute age
C-14, Texas Univ. laboratory, list: Pearson, F. J., Jr. 7017
Engineering geology
Salt mining, Belle Isle, Cargill's mine, long room method: Nicola, Nicholas J. 6851
Structural geology
Southern, salt domes, preferred alinements, recognition, statistical test: Harvey, J. R. 6916
Magmas
Differentiation
Crustal development, continental chronology: Wasserburg, G. J. 6837
Fe-Ti oxides: Lindsley, D. H. 6652
Liquid immiscibility: Skinner, Brian J. 6770
Muskox intrusion: Irvine, T. N. 6649
Oxygen fugacity, Hawaii, Kilauea Volcano: Sato, Motoaki. 6781
Podiform chromite deposits: Thayer, T. P. 6651
Ultramafic complexes, Alaska: Taylor, Hugh P., Jr. 6653
Genesis
Central America, West Indies, Cretaceous-Recent: Weyl, Richard. 6767
Geochemistry
Coexisting chromite-olivine: Jackson, Everett D. 6765
Magnetic field, Earth
Variations
C-14, dates, relation: Libby, Willard F. 6736
Magnetic surveys
Arctic Ocean
North American portion: King, Elizabeth R. 6787
Colorado
Mineral Belt: Case, J. E. 7172
Uncompahgre Plateau, anomalies, correlation with geology: Case, James E. 6780
Utah
Uncompahgre Plateau, anomalies, correlation with geology: Case, James E. 6780
Virginia
Leesburg area, Triassic diabase, anomaly due to lightning: Toewe, E. Clayton. 6832
Major-element analyses
Analcite
Solid solutions, infrared spectroscopy: Peters, Tj. 6997
Major-element analyses
Apatite
Ontario, Faraday township, carbonate-bearing: Gulbrandsen, R. A. 7035
Astrophyllite
Colorado, Mount Rosa area: Gross, Eugene B. 6699
Bytownite
Oceanic basalt: Bottinga, Y. 7036
Chabazite
Silica rich, California: Gude, Arthur J., 3d. 6987
Coconinoite
Arizona and Utah, new mineral: Young, E. J. 6939
Gaspeite
Quebec, Gaspe Peninsula, new nickel carbonate: Kohls, D. W. 7034
General
G-1, W-1 standards, mixed, X-ray fluorescence: Czamanske, Gerald K. 6859
Granite
Colorado, Redskin and Pikes Peak Granites: Hawley, C. C. 7119
Manganese nodules
Electron probe analysis, element correlations: Burns, R. G. 7032
Phosphate rock
U.S., western, Phosphoria Formation: Gulbrandsen, R. A. 6860
Phyllite
Virginia, central Piedmont, paragonite-bearing: Milici, R. C. 6639
Plagioclase
Phenocrysts in basaltic glass, electron-probe: Bottinga, Y. 7036
Riebeckite
Colorado, Mount Rosa area: Gross, Eugene B. 6699
Schist
California, Sonoma County, Franciscan Formation member: Lee, Donald E. 7120
Mammalia
Arctodus
Quaternary, Missouri, Pleistocene, Perkins Cave: Hawksley, Oscar. 7049
Quaternary
Missouri, Pleistocene, Perry County, cave assemblages: Oesch, Ronald D. 7050
Ursus
Quaternary, Missouri, Pleistocene, Perkins Cave: Hawksley, Oscar. 7049
Man, fossil
Evolution
Transitions, absolute dating: Oakley, Kenneth P. 6730
Geographic distribution
North America, sites, dating, C-14: Johnson, Frederick. 6721
Quaternary
British Columbia, Fraser Canyon, C-14 dates: Borden, Charles E. 6895

Man, fossil
Quaternary
North America, sites, C-14, dates: Haynes, C. Vance, Jr. 6739
United States, eastern, sites, C-14, dating: Griffin, James B. 6755
Manganese
Colorado
Resources, San Juan County, Eureka-Animas Forks area: Young, W. E. 7209
Geochemistry
Control by pH: Bartholome, Paul. 7185
Manitoba
Maps
Aeromagnetic, Kistigan Lake area: Canada Geological Survey. 6629
Aeromagnetic, Pechabau River area: Canada Geological Survey. 6632
Aeromagnetic, Stull Lake area: Canada Geological Survey. 6631
Aeromagnetic, Winnipeg mining district, Sheet 53 K/15: Canada Geological Survey. 6630
Aeromagnetic, Winnipeg mining district, Sheet 53 O/ 6: Canada Geological Survey. 6633
Aeromagnetic, Winnipeg mining district, Sheet 53 O/ 14: Canada Geological Survey. 6634
Mantle
Atlantic Ocean
Continental shelf, Nova Scotia, structure, gravity, seismic data: Keen, Charlotte. 6897
Composition
Elements, primordial: Ringwood, A. E. 6928
K/ Rb ratio, ultramafics, significance in differentiation: Stueber, Alan M. 6974
Mineral zones, chemical phase transitions: Ringwood, A. E. 6929
Elastic waves
Traveltimes, amplitudes, U.S., western, Salmon nuclear event: Jordan, James N. 6705
Experimental studies
Elastic properties, seismic parameter ϕ, MgO, Al_2O_3: Anderson, Orson L. 7059
Exploration
Deep drilling, land: Simmons, Gene. 6706
General
Upper Mantle Project, review: Oliver, Jack E. 6707
Physical properties
Geophysical evidence, effects of continental drift: MacDonald, Gordon J. F. 7044
Mechanical behavior, evidence, review: MacDonald, Gordon J. F. 6836
Processes
Convection, effect of low-viscosity layer: Weertman, J. 6990
Convection motions, orogeny, heat flow: Elsasser, Walter M. 6834
Structure
Geophysical evidence, effects of continental drift: MacDonald, Gordon J. F. 7044
Mantle
Structure
Mississippi, southern, seismic data: Warren, David H. 6703
United States, western, seismic data, Salmon nuclear event: Archambeau, C. B. 6711
Temperatures
Thermal gradients, instability, flow patterns: Elsasser, Walter M. 6834
Marine geology
Arctic
Canadian Archipelago, physiography, relation to crustal movements: Pelletier, B. R. 7040
Arctic Ocean
Beaufort Sea, crust, structure, seismic data: Milne, A. R. 7093
Atlantic Ocean
Bermuda Rise, sediment distribution, topography: Heezen, Bruce C. 7045
Mineral resources
World-wide, evaluation problems: Howard, Thomas E. 7168
Pacific Ocean
California borderland and Gulf of California, gravity surveys: Caputo, Michele. 7222
Hawaiian Islands area, tectonics, geomorphic and sedimentary evidence: Moberly, R., Jr. 6943
Revillagigedo archipelago, off Mexico, Isla San Benedicto: Richards, Adrian F. 7134
Sediments
Atlantic Ocean, Bermuda Rise, transport, Antarctic Bottom Current: Heezen, Bruce C. 7045
Grain-size analyzer, sedimentation tube: Schlee, John. 6970
Paleomagnetism, Quaternary: Harrison, C. G. A. 6814
Pelagic record, paleocurrents, climatic cycles, wind phenomena: Arrhenius, Gustaf. 6927
Sample treatment, splitter: McManus, Dean A. 6966
Structure
Arctic Ocean, magnetic data: King, Elizabeth R. 6787
United States
Continental shelf, research, interagency conference: Taney, Norman E. 6646
Maryland
Hydrogeology
Delmarva Peninsula, ground-water resources, aquifer recharge: Gardner, Richard A. 7127
Massachusetts
Hydrogeology
Housatonic River basin, Berkshire County, basic data: Norvitch, Ralph F. 6827
Maps
Hydrogeologic, Housatonic River basin, Berkshire County: Norvitch, Ralph F. 6827
Mercury
Analysis
Chemical and spectroscopic, sulfide ore: Dinnin, Joseph I. 7085

Mesozoic
Alaska
Alaska Range, contact metamorphism: Ragan, Donal M. 6828
Northern, microfaunal correlation: Bergquist, Harlan R. 6824
Wrangell Mountains, upper, biostratigraphy: Grantz, Arthur. 7105
Metals
Exploration
Quartz veins, evaluation, atomic absorption spectrophotometry: Price, Van. 6641
Utah
Stockton district, zonal distribution: Moore, William J. 7083
Metamorphic rocks
General
Absolute age, crustal development: Wasserburg, G. J. 6837
Petrology, structure, Oregon, Caviness quadrangle: Wolff, Ernest Nichols. 6662
Physical properties, elastic, shear wave velocity: Christensen, Nikolas I. 6906
Marble
Physical properties, aeolotropy, Lyndhurst formation, Ontario: Pegler, A. V. 6894
Physical properties, elastic, compressional wave velocity: Wang, Chi-Yuen. 6903
Metaigneous
General description, Alaska, Alaska Range, polymetamorphism: Ragan, Donal M. 6828
Mineral assemblages
California, Sonoma County, glaucophane schist: Lee, Donald E. 7120
Phyllite
Petrology, Virginia, central Piedmont: Milici, R. C. 6639
Rodingites
Relation to serpentinites: Thayer, T. P. 6994
Schist
Petrology, glaucophane, source rock, California: Bloxam, T. W. 6958
Serpentinites
Genesis, formation by constant-volume metasomatism: Thayer, T. P. 6994
Xenoliths
Geochemistry and mineralogy, Greenland, basalts: Melson, William G. 6822
Metamorphism
Contact
Experimental studies, siliceous limestone, melting: Wyllie, P. J. 6846
Rhyolite flow, Nevada, southern: Christiansen, Robert L. 6960
Schist, alteration from graywacke: Bloxam, T. W. 6958
Polymetamorphism
Alaska, Alaska Range, granulite, amphibolite, greenschist facies: Ragan, Donal M. 6828
P-T conditions
Blue schists, jadeite-rocks, low temperature-high pressure: Bloxam, T. W. 6958
Metamorphism
Retrograde
California, Sonoma County, glaucophane schist, mineral assemblages: Lee, Donald E. 7120
Metasomatism
Glaucophane schist
California, source rock: Bloxam, T. W. 6958
Process
Greenland, Ilimaussaq intrusion: Sorensen, Henning. 6645
Serpentinization, ultramafic rocks: Thayer, T. P. 6994
Rodingites
Relation to serpentinites: Thayer, T. P. 6994
Meteorites
Age
Radiation, cosmic, space erosion: Fisher, David E. 6723
Collections
California Division of Mines and Geology: Matthews, Robert A. 7153
Composition
Chondrites, halogen content: Reed, George W., Jr. 6856
Phosphates, irons and pallasites: Olsen, Edward. 6925
Cosmic dust
Microspherules, snow, ice-fog crystals, abundance: Kumai, Motoi. 6729
Discoveries
California, recovery problem: Butler, C. P. 7152
Estherville mesosiderite
Composition, heavy rare gas: Pepin, Robert O. 6904
Isotopes
Bruderheim, Bjurbole, lithium, anomalies, cf. granite G-1: Dews, Jon Robert. 6665
Canyon Diablo, silver, anomalies, cf. terrestrial: Dews, Jon Robert. 6665
Silver, Canyon Diablo: Dews, John R. 6817
Sulfur, differentiation: Kaplan, I. R. 6847
Mexico
Absolute age
C-14, Arizona Univ. Geochronology Laboratories, list: Haynes, C. Vance, Jr. 6985
C-14, Texas Univ. laboratory, list: Pearson, F. J., Jr. 7017
C-14, UCLA laboratory, list: Berger, Rainer. 6942
General
Ecology, Veracruz reefs, Foraminifera: Lidz, Louis. 6778
Maps
Geologic, Revillagigedo archipelago, Isla San Benedicto: Richards, Adrian F. 7134
Mineralogy
Hyalite opal, San Luis Potosi, iris effect: Sinkankas, John. 7197
Petrology
Revillagigedo archipelago, Isla San Benedicto, volcanics: Richards, Adrian F. 7134

Mexico
Volcanology
Paricutin Volcano, 1965: Segerstrom, Kenneth. 7113
Revillagigedo archipelago, Isla San Benedicto, volcanics: Richards, Adrian F. 7134
Michigan
Engineering geology
Rock mechanics, hydraulic fracturing, salt, Wayne County: Jacoby, Charles H. 6744
Geochemistry
Michigan basin, Salina salt, bromide profiles: Holser, William T. 6920
Maps
Aeromagnetic, Iron and Wakefield quadrangles: Philbin, P. W. 6697
Aeromagnetic, Thomaston, Carp River, North Ironwood, Little Girls Point quadrangles: Philbin, P. W. 6698
Micropaleontology
Cretaceous
Alaska, northern, faunal zones, correlation: Bergquist, Harlan R. 6824
Microscope methods
Spindle stage
Indicatrix orientation and 2V determination: Wright, Hedley G. 7001
Mineragraphy
Textures
Pyrite, sedimentary rocks: Kalliokoski, J. 7130
Mineral data
Actinolite
Optical absorption spectra of iron: White, William B. 6999
Alluaudite
Classification in isomorphous series, X-ray data: Fisher, D. Jerome. 7018
End members, nomenclature: Moore, Paul B. 7022
Analcime
Ca- and Sr-based, exchange properties: Ames, L. L., Jr. 7033
Solid solutions, X-ray data, melting: Peters, Tj. 6997
Apatite
Composition, infrared data, Ontario, Faraday township: Gulbrandsen, R. A. 7035
Binnite
Structure, refinement: Wuensch, B. J. 6700
Bytownite
Composition: Botinga, Y. 7036
Chabazite
California, San Bernardino County, composition: Gude, Arthur J., 3d. 6987
Chalcopyrite
Synthesis: Barnard, W. M. 7167
Chlorite
Optical absorption spectra of iron: White, William B. 6999
Chromite
Geochemistry: Ulmer, Gene C. 6650
Mineral data
Chrysotile asbestos
Morphology, nitrogen adsorption data: Naumann, A. W. 6995
Coconinoite
Composition and properties, new: Young, E. J. 6939
Coesite
Arizona, Meteor Crater, isolation from sandstone, method: Bohn, Ernst. 701
Diopside
Optical absorption spectra of iron: White, William B. 6999
Enstatite
Optical absorption spectra of iron: White, William B. 6999
Epididymite
Optical properties, dispersion, Greenland, Narssarssuk and Ilimaussaq: Petersen, Ole V. 7000
Epidote
Optical absorption spectra of iron: White, William B. 6999
Feldspar
Properties, elasticity, compressional wave velocity: Christensen, Nikolas I. 6819
Ferroselite
Wyoming, Powder River basin: Granger, H. C. 7118
Gaspeite
Composition and properties, Quebec, new: Kohls, D. W. 7034
Huhnerkobelite
Classification in isomorphous series, X-ray data: Fisher, D. Jerome. 7018
Iron-manganese alluaudites, end members: Moore, Paul B. 7022
Hyalite opal
Properties, iris-effect, Mexico, San Luis Potosi: Sinkankas, John. 7197
Inesite
Infrared absorption spectra, classified as pyroxenoid: Ryall, William R. 6998
Leucite
P-T stability, system kalsilite-silica-water: Scarfe, C. M. 6996
Mica, zinc-bearing
New Jersey, Franklin Furnace: Evans, B. W. 7047
Muscovite
Stability limit, upper: Velde, B. 6988
Olivine
Optical absorption spectra of iron: White, William B. 6999
Orpiment
Solubility, Na_2S-H_2O solution, deposition factors: Weissberg, B. G. 6862
Plagioclase
Idaho, Columbia River basalt, composition: Hoffer, Jerry M. 7002
Oscillatory zoning and clouding, origin: Bottinga, Y. 7036
Pyrite
Occurrence, sedimentary rocks: Kalliokoski, J. 7130

Mineral data
Pyroxene
Infrared absorption spectra: Ryall, William R. 6998
Phase equilibria, Ca-rich, Mg-rich pairs, kimberlites: Davis, B. T. C. 6900
Schroeckingerite
Properties, New Mexico, Ambrosia Lake district: Barczak, V. J. 6993
Sphalerite
Geochemistry, experimental studies: Barton, Paul B., Jr. 7183
Stishovite
Arizona, Meteor Crator, isolation from sandstone, method: Bohn, Ernst. 7131
Tetrahedrite
Structure, compared with binnite: Wuensch, B. J. 6700
Varulite
Iron-manganese alluaudites, end members: Moore, Paul B. 7022
Wairakite
Exchange properties and synthesis: Ames, L. L., Jr. 7033
Willemite
Composition, Ge content, New Mexico, Utah: Scheffer, Herman W. 6861
Zeolites
Sedimentary rocks, modes of occurrence, origin, reactions: Hay, Richard L. 6762
Mineral deposits, genesis
Borates
California, Kramer lake beds, ulexite and colemanite zones: Bowser, C. J. 6853
Classification
Zeolites, sedimentary rocks, modes of occurrence, reactions: Hay, Richard L. 6762
Copper
Quebec, Gaspe, Holland township: Brummer, J. J. 6797
Geochemical affinities
Iron, manganese, seawater: Bartholome, Paul. 7185
Gypsum
Virginia, Saltville area: Cooper, Byron N. 6759
Igneous processes
Chromite, podiform deposits: Thayer, T. P. 6651
Chromite, Stillwater Complex: Jackson, Everett D. 6765
Copper, Utah: Field, Cyrus W. 7184
Iron, ultramafics, Alaska: Taylor, Hugh P., Jr. 6653
Nickel, Canada: Kilburn, L. C. 6636
Sulfur solubility, mafic magma: Skinner, Brian J. 6770
Iron
Missouri, Precambrian: Snyder, Frank G. 6654
Metals
Utah, Stockton district, hypogene environmental control: Moore, William J. 7083
Mineral deposits, genesis
Nickel
North America: Cornwall, Henry R. 6758
Ontario, Sudbury: Cowan, J. C. 6763
Ontario, Sudbury: Souch, B. E. 6773
Ore-forming fluids
Chalcopyrite synthesis: Barnard, W. M. 7167
Ores in sedimentary rocks
Diagenetic pyrite: Kalliokoski, J. 7130
Metal sorption by humate, experimental: Swanson, Vernon E. 7196
Phosphate
Atlantic Coastal Plain: McConnell, Duncan. 7163
Polymetallic ores
Missouri, Fredericktown area: ElBaz, Farouk El Sayed. 6772
Salt
Virginia, Saltville area: Cooper, Byron N. 6759
Supergene processes
Bauxite, Alabama, Jamaica: Clarke, Otis M., Jr. 7162
Uranium
Wyoming, Shirley basin: Harshman, E. N. 7081
Zeolites
Sedimentary rocks, modes of occurrence, reactions: Hay, Richard L. 6762
Mineral economics
Marine deposits
Evaluation, problems: Howard, Thomas E. 7168
Mineral exploration
General
Resources, evaluation by geologic mapping, Kentucky: McGrain, Preston. 7175
Geophysical methods
Electrical logging, evaporites: Alger, R. P. 6848
Ore guides
Colorado Mineral Belt, geophysical data: Case, J. E. 7172
Wyoming, uranium, roll-type: King, J. W. 7186
Mineral resources
Genesis
Geochemical weathering, rocks, minerals, products: Keller, W. D. 6691
Mineral zoning
Porphyry copper
Utah, Bingham, sulfur isotopes: Field, Cyrus W. 7184
Replacement deposit
Utah, Stockton district, metals: Moore, William J. 7083
Zinc-lead deposits
Lead-isotope ratios: Heyl, A. V. 7121
Mineralogy
Classification
Huhnerkobelite and alluaudite: Fisher, D. Jerome. 7018

Mineralogy
Classification
Huhnerkobelite and alluaudite: Moore, Paul B. 7022
Crystal growth
Diffusion control of plagioclase crystallization: Bottinga, Y. 7036
Salt, brine cavities, solid particle inclusions, effects, habit modification: Shuman, A. Cornwell. 6922
Education
Crystal chemistry, principles, laboratory, Harpur College, N. Y.: Roberson, Herman E. 6689
Crystal chemistry, principles, laboratory, project: Bodine, Marc W., Jr. 6690
Identification techniques
Carbonate minerals, thermogravimetry, X-ray diffraction: McCaleb, Stanley B. 7125
Physical properties
Specific gravity, micropycnometer for measurement: May, Irving. 6975
Mining geology
Evaluation
Metallic mineralization, quartz vein, atomic absorption spectrophotometry: Price, Van. 6641
Statistical methods, sampling: Hazen, Scott W. 7171
Technology
Joint diagrams, critical survey, informative value in coal fields: Kirchmayer, Martin. 6961
Potash, rock mechanics, deformation measurement: Baar, C. A. 6746
Rock mechanics, photoelastic measurement, disc technique: Heidecker, E. 6964
Rock mechanics, photoelastic measurement, stress and strain: Roberts, Albert. 6963
Salt domes, long room sections, Louisiana, Belle Isle, Cargill's mine: Nicola, Nicholas J. 6851
Salt, hydraulic fracturing, effect of geology: Jacoby, Charles H. 6744
Salt mine field, brine wells, electrical logging, application: Bird, James M. 6893
Salt, pillar movement, measurement: Peyfuss, Kurt F. 6749
Salt, rock mechanics, control by mine design, Ohio: Smith, John D. 6892
Salt, structural behavior, continuum theory, model: Serata, Shosei. 6745
Slope stability, open pit, Florida: Gardner, Charles H. 7128
Minnesota
Absolute age
Red Lake bog, peat, C-14: Farnham, R. S. 6945
Economic geology
Peat, Beltrami County, Red Lake bog: Farnham, R. S. 6945
Maps
Geologic, Saint Paul sheet, bedrock: Sloan, R. E. 6673
Mississippi
Economic geology
Salt, Tatum Dome, exploration, 3-D velocity logs: Christensen, Dean M. 6923
Geophysical surveys
Hattiesburg area, Tatum Salt Dome, acoustical logging: Christensen, Dean M. 6923
Southern, seismic refraction, crust, mantle structure: Warren, David H. 6703
Structural geology
Southern, crust, mantle, seismic data: Warren, David H. 6703
Mississippi Valley
Geochemistry
Lead isotopes: Heyl, A. V. 7121
Geomorphology
Embayment, terraces, marine, Quaternary: Cooke, C. Wythe. 6793
Mississippian
Arkansas
Fayetteville, pteridophytes, Fayetteville Formation: Mapes, Royal H. 6845
Illinois
Southern, Ostracoda, *Polytylites*, Chester Series: McGuire, Odell S. 6887
Kentucky
Western, Ostracoda, *Polytylites*, Chester Series: McGuire, Odell S. 6887
Oklahoma
Vinita area, Brachiopoda, Fayetteville Shale, *Reticulariina*: Branson, Carl C. 6932
Missouri
Absolute age
C-14, Gakushuin Univ. laboratory, list: Kigoshi, Kunihiko. 6946
Economic geology
Iron, Precambrian: Snyder, Frank G. 6654
Polymetallic ores, Fredericktown area: ElBaz, Farouk El Sayed. 6772
Paleontology
Mammalia, Pleistocene, Perkins Cave, bear bones: Hawksley, Oscar. 7049
Mammalia, Pleistocene, Perry County, cave assemblages: Oesch, Ronald D. 7050
Petrology
Fredericktown area, sulfide deposits, layered: ElBaz, Farouk El Sayed. 6772
Mollusca
Jurassic
North America, Middle, cf. Europe, Morocco: Mongin, Denise. 6771
Quaternary
California, San Pedro, Pleistocene terrace, list: Chace, Emery P. 7157
North Carolina, northeastern, Pamlico Formation, Pleistocene: Richards, Horace G. 6643
Montana
Economic geology
Chromite, Stillwater Complex: Jackson, Everett D. 6765
Coal, eastern: Averitt, Paul. 6802
Coal, mining history: Morgan, Thomas. 6801

Montana
Economic geology
Coal, resources: Bateman, Andrew F., Jr. 6803
Coal, resources, symposium: Groff, S. L. 6804
General
Bibliography, ground-water studies: Botz, Maxwell K. 6672
Geochemistry
Chromite, Stillwater Complex: Jackson, Everett D. 6765
Maps
Ground-water studies, index: Botz, Maxwell K. 6672
Mineral resources, coal: Bateman, Andrew F., Jr. 6803
Mineral resources, eastern, coal: Averitt, Paul. 6802

Nebraska
Paleontology
Aves, Pliocene, stork, n. gen. n. sp.: Short, Lester L., Jr. 7145
Sedimentary petrology
Northwestern, soil profile, late Eocene: Pettyjohn, Wayne A. 7108

Nevada
Absolute age
Granitic rocks, K–Ar, synchronous plutonic and volcanic: Armstrong, Richard Lee 6889
Pintwater Cave, coprolite, C 14: Berger, Rainer. 6901
Earthquakes
Microseisms, portable seismograph observation: Oliver, Jack. 6955
Economic geology
Beryllium: Shawe, D. R. 7084
Gold, exploration: Hardie, Byron S. 7170
Gold, mercury, Cortez district: Erickson, R. L. 6896
Silver, resources, Silver Peak: Ebbley, Norman. 7126
Engineering geology
Materials, properties, elasticity, granitic rocks in tunnels: Carroll, Roderick D. 7103
Geochemistry
Cortez district, geochemical prospecting, gold anomaly: Erickson, R. L. 6896
Geophysical surveys
Nevada Test Site, cavities, near-surface, seismic: Watkins, Joel S. 7052
Hydrogeology
Sand Springs Range, ground water, nuclear explosion effects: Hazleton–Nuclear Science Corp. 6830
White River area, Paleozoic carbonate rocks, ground water, interbasin system: Eakin, Thomas E. 6866
Maps
Geologic, Buckboard Mesa quadrangle: Byers, F. M., Jr. 7150
Geologic, Fortymile Canyon area: Christiansen, Robert L. 6960

Nevada
Mineralogy
Heavy minerals, Connors Pass quadrangle, stream sediments, provenance: Young, E. J. 7114
Paleontology
Brachiopoda, Devonian, Denay Limestone, Roberts Mts.: Johnson, J. G. 6869
Foraminifera, Paleozoic, Bird Spring Group, Clark County, fusulinids: Cassity, P. E. 6967
Palynomorphs, Quaternary, Pintwater Cave, coprolite: Berger, Rainer. 6901
Petrology
Southern, Comb Peak, rhyolite, flow structures: Christiansen, Robert L. 6960
Sedimentary petrology
Arrow Canyon Range, Lower Bird Spring Group: Heath, Christopher Peter Macclesfield. 6656
Stratigraphy
Devonian, Denay Limestone, new name, Roberts Mts.: Johnson, J. G. 6869
Pennsylvanian–Permian, Lower Bird Spring Group, Arrow Canyon Range: Heath, Christopher Peter Macclesfield. 6656
Precambrian–Cambrian, southern Great Basin, correlation: Stewart, John H. 7109
Tertiary–Quaternary, Buckboard Mesa quadrangle, sections: Byers, F. M., Jr. 7150
Structural geology
Fortymile Canyon area: Christiansen, Robert L. 6960

New Brunswick
Economic geology
Potash, possibilities, Cumberland basin, bromine investigations: Baar, C. A. 6849

New Hampshire
Paleomagnetism
Mesozoic, White Mountains, magma series: Opdyke, N. D. 6815

New Jersey
Mineralogy
Mica, zinc bearing, Franklin Furnace: Evans, B. W. 7047

New Mexico
Economic geology
Beryllium, southwestern: Shawe, D. R. 7084
Potash, Carlsbad district, barren halite zones, genesis: Linn, Kurt O. 6921
Geochemistry
Carlsbad district, halite zones, potash ore: Linn, Kurt O. 6921
Delaware basin, evaporites, bromide profiles, halite: Holser, William T. 6920
Germanium in willemite: Scheffer, Herman W. 6861
Mineralogy
Schroeckingerite, Ambrosia Lake district: Barczak, V. J. 6993
Willemite, Ge content: Scheffer, Herman W. 6861

New Mexico
Sedimentary petrology
Jornada del Muerto basin, southern, alluvial-fan, sedimentation and soil formation: Gile, L. H. 7146

New York
Engineering geology
Rock mechanics, hydraulic fracturing, salt, Ludlowville, Watkins Glen: Jacoby, Charles H. 6744
General
Curricula, New Paltz College of State University, earth science teachers, core course: Connally, G. Gordon. 7141
Geochemistry
Onondaga Group, carbohydrate content, disribuion: Swain, F. M. 6926
Paleontology
Bacteria, Silurian, rock salt, Myers mine, living: Dombrowski, H. J. 6918
Trilobita, Cambrian, Taconic sequence, North Chatham area, new faunule: Rasetti, Franco 7132
Sedimentary petrology
Leicester marcasite, Clinton ironstone, diagenetic pyritization: Kalliokoski, J. 7130
Onondaga Group, carbohydrate content, relation to source and deposition: Swain, F. M. 6926

Newfoundland
Sedimentary petrology
Wabana pyrite beds: Kalliokoski, J. 7130

Nickel
Canada
Ore deposits, general: Kilburn, L. C. 6636
Geochemistry
Experimental studies: Craig, J. R. 6638
Experimental studies: Kullerud, G. 6637
North America
Resources, occurrence, genesis: Cornwall, Henry R. 6758
Ontario
Sudbury: Cowan, J. C. 6763
Sudbury: Souch, B. E. 6773

North America
Absolute age
C-14, archeological, sites: Haynes, C. Vance, Jr. 6739
C-14, Geochron Laboratories, list: Krueger, Harold W. 6991
C-14, Michigan Univ. laboratory, list: Crane, H. R. 7013
C-14, Pennsylvania Univ. laboratory, list: Stuckenrath, Robert, Jr. 7015
Man, fossil, sites, C-14: Johnson, Frederick. 6721
Precambrian, crustal development, Grenville province: Wasserburg, G. J. 6837
Economic geology
Nickel, occurrence and genesis: Cornwall, Henry R. 6758
Paleontology
Crinoidea, Devonian-Permian, *Allagecrinidae*: Strimple, Harrell L. 6933

North America
Paleontology
Man, fossil, Quaternary, sites, C-14 dates: Haynes, C. Vance, Jr. 6739
Man, fossil, sites, C-14 dating: Johnson, Frederick. 6721
Mollusca, Jurassic, Middle, cf. Europe, Morocco: Mongin, Denise. 6771
Palynomorphs, Mesozoic and Tertiary, catalog: Kremp, G. O. W. 6872
Stromatoporoidea, Ordovician-Devonian, microstructures, taxonomy: Stearn, Colin W. 6885
Stratigraphy
Ordovician, graptolite zones, correlation, Great Britain: Berry, William B. N. 6776
Precambrian, distribution, nomenclature, correlation, tectonic divisions: Schmidt, Klaus. 6870
Structural geology
Orogeny and epeirogeny, cratonic tectonism, sequences: Sloss, L. L. 6937

North Carolina
Economic geology
Phosphate, Lee Creek mine, ground-water problem: Welby, Charles W. 7176
Hydrogeology
Lee Creek phosphate mine, ground-water changes: Welby, Charles W. 7176
Paleontology
Mollusca, Pleistocene, Pamlico Formation, northeastern: Richards, Horace G. 6643

Northwest Territories
Geomorphology
Iniwik area, permafrost, distribution under lake: Johnston, G. H. 7048
Geophysical surveys
Ellesmere and Axel Heiberg Islands, radio echo, glaciers, thickness: Evans, S. 6865
Glacial geology
Ellesmere and Axel Heiberg Islands, glaciers, thickness, radio echo survey: Evans, S. 6865
Maps
Aeromagnetic, Keewatin, Pork Peninsula area: Canada Geological Survey. 6676
Petrology
Muskox intrusion: Irvine, T. N. 6649
Structural geology
Fractures, lineaments, Kennedy Channel shear rotation, continental drift: Hilgenberg, Ott Christoph. 6667

Nova Scotia
Economic geology
Potash, possibilities, Cumberland basin, bromine investigations: Baar, C. A. 6849
Maps
Aeromagnetic, Country Harbour area: Canada Geological Survey. 6598
Aeromagnetic, Framboise area: Canada Geological Survey. 6597
Aeromagnetic, Larrys River area: Canada Geological Survey. 6596

Nova Scotia
Paleontology
Bacteria, Mississippian, rock salt, Pugwash, living: Dombrowski, H. J. 6918
Nuclear explosions
Applications
Waste disposal in rubble chimneys, model studies: Korver, John A. 6881
Crustal studies
Seismological information, advances: Press, Frank. 6930
Deformation
Salmon event, Mississippi, post-explosion effects: Rawson, D. 6724
Surface displacements, calculation: Bycroft, G. N. 7064
Electrical effects
Transients, underground events, dipole source: Zablocki, C. J. 6899
Hydrogeology
Project Shoal, 1963, ground-water contamination, Nevada: Hazleton-Nuclear Science Corp. 6830
Project Shoal, 1963
Ground-water contamination, Nevada: Hazleton-Nuclear Science Corp. 6830
Seismic effects
Primary waves, amplitudes and energy, elastic source: Trembly, Lynn D. 7096
P-wave coupling, effect of medium: Springer, Donald L. 7060
Salmon event, decoupling: Patterson, Dan W. 6725
Salmon event, epicenter, determination: Herrin, Eugene. 6712
Salmon event, free-field motion: Rogers, Leo A. 6726
Salmon event, Oct. 22, 1964, general: Werth, Glenn. 6704
Salmon event, P-waves, first arrival, amplitudes: Springer, Donald L. 6710
Salmon event, P-waves, interpretation: Archambeau, C. B. 6711
Salmon event, traveltimes, amplitudes, U.S., western: Jordan, James N. 6705
Ocean basins
Evolution
Permanency, global shear patterns: Menard, H. W. 6855
Oceanography
Education
Marine geology, reading course, selected references: Schubel, J. R. 7138
Ohio
Economic geology
Salt, Fairport Harbor mine, impurities, solubility: Andelfinger, George F. 6850
Engineering geology
Rock mechanics, Fairport salt mine, control by mine design: Smith, John D. 6892
Rock mechanics, Painesville area, salt mining: Emery, C. L. 6750
Ohio
Hydrogeology
Piketon area, vertical permeability of aquifer, electric-analog study: Norris, S. E. 7205
Sedimentary petrology
Maumee area, Cayugan Series, stromatolite mound, microfacies: Textoris, Daniel A. 6807
Oklahoma
General
Bibliography, 1965: Howe, Jane. 6843
Paleontology
Brachiopoda, Mississippian, Fayetteville shale, *Reticulariina*: Branson, Carl C. 6932
Brachiopoda, Pennsylvanian, east-central, spiriferid: Branson, Carl C. 6935
Crinoidea, Permian, Red Eagle Limestone, *Isoallagecrinus*: Strimple, Harrell L. 6933
Palynomorphs, Pennsylvanian, Boggy Formation, northeastern, new spore: Urban, L. L. 6931
Pelecypoda, Ordovician, Bromide Formation, *Conocardium*: Branson, Carl C. 6841
Stratigraphy
Carboniferous, Goddard Formation, unconformity, possibility: Beckman, W. A., Jr. 6805
Structural geology
Atoka, Bryan Counties, fault systems, relations: Harlton, Bruce H. 6806
Marshall and Bryan Counties, unconformity: Beckman, W. A., Jr. 6805
Ontario
Economic geology
Nickel, copper, Sudbury: Cowan, J. C. 6763
Nickel, copper, Sudbury: Souch, B. E. 6773
Engineering geology
Rock mechanics, Lyndhurst Marble, Potsdam Sandstone, prefracture analysis: Pegler, A. V. 6894
Geochemistry
Michigan basin, Salina salt, bromide profiles: Holser, William T. 6920
Maps
Aeromagnetic, Asipoquobah Lake area: Canada Geological Survey. 6622
Aeromagnetic, Blackbear Lake area: Canada Geological Survey. 6624
Aeromagnetic, Fidler Lake area: Canada Geological Survey. 6615
Aeromagnetic, Kenora District, Sheet 53 F/7: Canada Geological Survey. 6616
Aeromagnetic, Kenora District, Sheet 53 F/10: Canada Geological Survey. 6617
Aeromagnetic, Kenora District, Sheet 53 G/3: Canada Geological Survey. 6620
Aeromagnetic, Kenora District, Sheet 53 J/14: Canada Geological Survey. 6627
Aeromagnetic, Kenora mining district, Sheet 53 O/E6: Canada Geological Survey. 6633
Aeromagnetic, Knife Lake area: Canada Geological Survey. 6623
Aeromagnetic, Munekun Lake area: Canada Geological Survey. 6621

Ontario
Maps
Aeromagnetic, Pasquatchai River area: Canada Geological Survey. 6628
Aeromagnetic, Pullan Lake area: Canada Geological Survey. 6618
Aeromagnetic, Sherman River area: Canada Geological Survey. 6626
Aeromagnetic, Stull Lake area: Canada Geological Survey. 6631
Aeromagnetic, Swan Lake area: Canada Geological Survey. 6625
Aeromagnetic, Pierce Lake area: Canada Geological Survey. 6619
Mineralogy
Apatite, carbonate bearing, Faraday township: Gulbrandsen, R. A. 7035
Stratigraphy
Quaternary, Port Talbot area, interstadial deposits: Dreimanis, Aleksis. 6720
Ordovician
General
Correlation, North America, Great Britain, graptolite zones: Berry, William B. N. 6776
Oklahoma
Carter County, Pelecypoda, Bromide Formation: Branson, Carl C. 6841
Yukon
Northern, Trilobita, Road River Formation: Lenz, A. C. 6879
Oregon
Absolute age
C 14, Texas Univ. laboratory, list: Pearson, F. J., Jr. 7017
Areal geology
Caviness quadrangle, northern: Wolff, Ernest Nichols. 6662
Geophysical surveys
Southwestern, gravity: Blank, H. Richard, Jr. 7115
Stratigraphy
Tertiary, Columbia River Group and Mascall Formation, Canyon City quadrangle: Thayer, T. P. 7110
Structural geology
Southwestern, crust, gravity data: Blank, H. Richard, Jr. 7115
Organic materials
Humates
Florida, metal sorption: Swanson, Vernon E. 7196
Hydrocarbons
Sapropel laminae, Florissant Lake deposits, Colorado: McLeroy, Carol Ann. 6829
Orogeny
Causes
Mantle convection motions, thermal instability, oceanic ridges: Elsasser, Walter M. 6834
General
United States, western, relation to plutonism: Ramspott, L. D. 6792
Orogeny
Ouachita
Oklahoma, Arbuckle fault system, relations with Ouachita system: Harlton, Bruce H. 6806
Periodicity
North America, cratonic sequences, tectonic behavior: Sloss, L. L. 6937
Ostracoda
Polytylites
Mississippian, Kentucky and Illinois, Chester Series, population: McGuire, Odell S. 6887
Tertiary
West Indies, Antigua Formation, Oligocene: Bold, W. A. van den. 7027
Theriosynoecum
Jurassic–Cretaceous, taxonomy, emended: Branson, Carl C. 6838
Theriosynoecum wyomingense
Jurassic, Wyoming, Johnson County, Morrison Formation, type species: Branson, Carl C. 6838
Oxygen
Isotopes
Sea water, enrichment by evaporation: Lloyd, R. M. 6857
Pacific Ocean
Earthquakes
Tsunami, power spectrums, time changes between stations: Loomis, Harold G. 7198
Geochemistry
Northern, sediments, analyses, area comparisons: Palacas, James G. 7112
Geophysical surveys
California borderland and Gulf of California, gravity: Caputo, Michele. 7222
Paleoclimatology
Quaternary, temperatures, faunas, island, endemism: Briggs, John C. 6796
Petrology
Plagioclase and glass in oceanic basalt: Bottinga, Y. 7036
Structural geology
Revillagigedo archipelago, Isla San Benedicto, Clarion fracture zone, volcanic ridges: Richards, Adrian F. 7134
Paleclimatology
Indicators
Ocean sediments, pelagic record, ocean, atmosphere, outer space phenomena: Arrhenius, Gustaf. 6927
Paleobotany
Catalog
Palynomorphs, Mesozoic and Tertiary: Kremp, G. O. W. 6872
Distribution
Continental drift, climatic zones, adaptive relations: Radforth, N. W. 7019
Environmental analysis
Climatic zones, latitudinal changes, continental drift: Radforth, N. W. 7019
Paleoclimatology
Quaternary
California, central, Pleistocene, late: Addicott, W. O. 6644

Paleoclimatology
Quaternary
Nevada, Las Vegas area, coprolite, palynology: Berger, Rainer. 6901
Temperature
Atmosphere, ocean, effect, C-14 dating, wood: Damon, Paul E. 6715
Atmosphere, ocean, effect, C-14 dating, wood: Schell, William R. 6910
Quaternary, marine, endemism, fauna: Briggs, John C. 6796
Tertiary
Colorado, Florissant Lake: McLeroy, Carol Ann. 6829
Paleoecology
Analysis
Environmental stability and life, ocean-atmosphere interaction: Weyl, Peter K. 6821
Changes
Evolutionary adaptation, principles: Williams, George C. 7135
Gymnosperms
Permian, Texas: Mamay, Sergius H. 6677
Indicators
Ocean sediments, pelagic record, ocean, atmosphere, outer space phenomena: Arrhenius, Gustaf. 6927
Invertebrata
Marine, Pleistocene, California, central: Addicott, W. O. 6644
Quaternary
Lacustrine, California, Searles Lake evaporites: Smith, George I. 6668
Marine, oceanic islands, faunas, endemism: Briggs, John C. 6796
Marine, Pleistocene, California, central: Addicott, W. O. 6644
Reptilia
Cretaceous, aquatic adaptation, United States, western, mosasaur: Russell, Dale Alan. 6661
Tertiary
Lacustrine, Florissant Lake deposits, Oligocene: McLeroy, Carol Ann. 6829
Lacustrine, Wyoming, Green River Formation, evaporite deposition: Bradley, W. H. 6679
Paleogeography
Cretaceous
California, Ventura County: Rust, B. R. 6831
Jurassic
North America, Mollusca, cf. Europe, Morocco: Mongin, Denise. 6771
Paleomagnetism
Applications
Continental drift: Deutsch, Ernst R. 7043
Mesozoic
New Hampshire, Vermont, White Mts., magma series: Opdyke, N. D. 6815
Methods
Strength, variation, C-14 dates, relation: Libby, Willard F. 6736
Quaternary
Sediments, deep-sea: Harrison, C. G. A. 6814
Paleontology
Fossilization
Diagenetic pyritization: Kalliokoski, J. 7130
Methods
Staining techniques, planktonic foraminifers: Berger, W. H. 6863
Taxonomy
Gastropoda, *Oliva*, lectotypes of *Voluta* Linnaeus species: Olsson, Axel A. 6940
Paleozoic
Alaska
Alaska Range, regional metamorphism and migmatization: Ragan, Donal M. 6828
General
Crinoidea, *Allagecrinidae*, Devonian-Permian: Strimple, Harrell L. 6933
Stromatoporoidea, microstructures, taxonomy: Stearn, Colin W. 6885
Palynology
Quaternary
Nevada, Pintwater Cave, coprolite, interpretation: Berger, Rainer. 6901
Tertiary
Alaska, Cook Inlet region, floral correlation, time-stratigraphic units: Wolfe, Jack A. 6911
Palynomorphs
Cappasporites distortus, n. gen., n. sp.
Pennsylvanian, Oklahoma, northeastern, Boggy Formation: Urban, L. L. 6931
Mesozoic
Catalog: Kremp, G. O. W. 6872
Tertiary
Catalog: Kremp, G. O. W. 6872
Peat
Minnesota
Beltrami County, Red Lake bog, resources: Farnham, R. S. 6945
Pebbles
Orientation
Stream deposits, cross-stratified: SenGupta, Supriya. 7028
Shape analysis
Classification: Smalley, I. J. 6972
Stream deposits, relation to current direction: SenGupta, Supriya. 7028
South Dakota
Bethlehem and Jewel Caves, naturally polished: Deal, Dwight E. 7056
Pelecypoda
Conocardium, sp.
Ordovician, Oklahoma, Carter County, Bromide Formation: Branson, Carl C. 6841
Pennsylvania
Geochemistry
Onondaga Group, carbohydrate content, distribution: Swain, F. M. 6926
Geomorphology
Cumberland Valley, southern, caves, erosion surfaces, correlation: White, William B. 7054

Pennsylvania
Sedimentary petrology
Onondaga Group, carbohydrate content, relation to source and deposition: Swain, F. M. 6926
Pennsylvanian
Alabama
Sand and Lookout Mts., coal beds, correlation: Shotts, Reynold Q. 6965
Colorado
Central, Minturn Formation: Boggs, Sam, Jr. 6808
Nevada
Arrow Canyon Range, Lower Bird Spring Group: Heath, Christopher Peter Macclesfield. 6656
Clark County, Arrow Canyon, Foraminifera, Bird Spring Group, fusulinids: Cassity, P. E. 6967
Oklahoma
East-central, Brachiopoda, spiriferid: Branson, Carl C. 6935
Northeastern, palynomorphs, Boggy Formation, new spore: Urban, L. L. 6931
Texas
Central, Brachiopoda, spiriferid: Branson, Carl C. 6935
United States
Southwestern, Foraminifera, *Fusulina*, septal folding, identification, evolution: Elias, Maxim K. 6839
Utah
Moab region, Hermosa Formation, Paradox Member, halite units: Raup, Omer B. 6761
Permafrost
Carbon-14 dating
Effects: Campbell, John M. 6731
Hydrodynamics
Moisture flow, frozen soils, Fairbanks silt, Alaska: Hoekstra, Pieter. 6941
Northwest Territories
Iniwik area, distribution under lake: Johnston, G. H. 7048
Permeability
Clays
Hydraulic conductivity, Darcy's law in kaolinite, validity, technique: Olsen, Harold W. 6868
Soils
Fairbanks silt, Alaska, moisture movement below freezing temperatures: Hoekstra, Pieter. 6941
Permian
Arizona
Holbrook basin area, Supai Formation, evaporite deposits: Peirce, H. Wesley. 6915
General
Crinoidea, Indocrinidae, n. fam., taxonomy: Strimple, Harrell L. 6840
Nevada
Arrow Canyon Range, Lower Bird Spring Group: Heath, Christopher Peter Macclesfield. 6656
Permian
Nevada
Clark County, Arrow Canyon, Foraminifera, Bird Spring Group, fusulinids: Cassity, P. E. 6967
New Mexico
Salado Formation, genesis of evaporites: Adams, Samuel S. 7179
Oklahoma
Osage County, Crinoidea, Red Eagle Limestone: Strimple, Harrell L. 6933
Texas
Baylor County, gymnosperms, pteridosperm, evolution: Mamay, Sergius H. 6677
Glass Mountains, Crinoidea, Word Formation, n. gen.: Strimple, Harrell L. 6840
Salado Formation, genesis of evaporites: Adams, Samuel S. 7179
Petrofabrics
Interpretation
Salt rock, halite orientation, Louisiana, Winnfield dome: Schwerdtner, W. M. 6678
Potash rock
Saskatchewan, Esterhazy, Prairie Evaporite: Clark, A. R. 6854
Salt rock
Louisiana, Winnfield dome, halite orientaion: Schwerdtner, W. M. 6678
Petroleum
Exploration
Formation-water analysis, techniques, recommendations: Noad, D. F. 6826
Genesis
Organic, evidence: Hedberg, Hollis D. 7200
Gulf Coastal Plain
Salt domes, review: Halbouty, Michael T. 6878
Kentucky
Martin quadrangle, resources: Rice, Charles L. 7136
Source rocks
Characteristics, stratigraphic analysis: Holmquest, Harold J. 6775
Phase equilibria
Albite-anorthite
Phenocryst and groundmass plagioclase in basalt: Hoffer, Jerry M. 7002
Plagioclase-liquid relations: Bottinga, Y. 7036
Ca-analcime
Equilibrium with Na solution: Ames, L. L., Jr. 7033
CaO-SiO_2-CO_2-H_2O
Petrogenetic model, application, carbonatites: Wyllie, P. J. 6846
Ca-S-O water
Gypsum, anhydrite, equilibrium temperature: Hardie, L. A. 6681
Cu-Fe-Ni-S
Experimental sudies: Craig, J. R. 6638
Experimental studies: Kullerud, G. 6637
Fe-Ti-O
Oxygen activity: Lindsley, D. H. 6652

Phase equilibria
Fe–Zn–S
Experimental studies: Barton, Paul B., Jr. 7183
Kalsilite–silica–water
Stability limits of leucite: Scarfe, C. M. 6996
Mantle
Theoretical treatment, mineral zones: Ringwood, A. E. 6929
Mg–Cr–Al–Fe–O
Experimental studies: Ulmer, Gene C. 6650
Mg–Fe–Si–O system
Retrograde melting: Speidel, D. H. 6820
Retrograde melting: Toulmin, Priestley, 3d. 6888
Muscovite
Stability limit, upper: Velde, B. 6988
Na_2S–H_2O
Orpiment solubility: Weissberg, B. G. 6862
Nepheline–albite–water
Melting, analcite solid solutions: Peters, Tj. 6997
Pyroxene
Ca–rich, Mg–rich pairs, equilibrium temperatures, kimberlites: Davis, B. T. C. 6900
Phosphate
Florida
Engineering geology: Gardner, Charles H. 7128
Resources, land pebble deposits: Houston, Wesley M. 7178
Genesis
Estuarine environment: McConnell, Duncan. 7163
Geochemistry
Rare earths, fractionation: Altschuler, Zalman S. 7181
North Carolina
Lee Creek mine, dewatering: Welby, Charles W. 7176
Tennessee
Sevier County, Ocoee Series, resources: Wedow, Helmuth. 7129
United States
Eastern, production: Cathcart, James B. 7177
Photogeology
Interpretation
Earth science, laboratory, high–school level, stereograms: Mueller, Bruce E. 6692
Polymetallic ores
Missouri
Fredericktown area, genesis: ElBaz, Farouk El Sayed. 6772
Popular and elementary geology
Evolution
Birds around the world: Amadon, Dean. 6876
Water
Resources development: Leopold, Luna B. 6702
Porosity
Rock
Determination, laboratory, Russell–type volumeter: Grubbs, David M. 6642
Potash
Canada
Eastern, Cumberland basin, possibilities, bromine investigations: Baar, C. A. 6849
New Mexico
Carlsbad district, halite zones, genesis: Linn, Kurt O. 6921
Saskatchewan
Exploration, carnallite: Hurd, Donald W. 7180
Precambrian
Absolute age
Chronologic development: Wasserburg, G. J. 6837
Alaska
Alaska Range, regional metamorphism: Ragan, Donal M. 6828
California
Spring Mountains–Death Valley and White–Inyo Mts. regions, correlation: Stewart, John H. 7109
Nevada
Spring Mountains–Death Valley region, stratigraphy, correlation: Stewart, John H. 7109
North America
Nomenclature, correlation, distribution, tectonic divisions: Schmidt, Klaus. 6870
Quebec
Lake Assinica map–area: Gillett, L. B. 6695
Montauban–Colbert map–area: Pyke, D. R. 6764
Prince Edward Island
Economic geology
Potash, possibilities, Cumberland basin, bromine investigations: Baar, C. A. 6849
Sedimentary petrology
Tracadie Bay, bottom sediments: Bartlett, G. A. 6798
Pteridophytes
Lepidophloios, sp.
Mississippian, Arkansas, Fayetteville Formation, complete branch: Mapes, Royal H. 6845
Puerto Rico
Geomorphology
Rio Grande de Manati, channel changes, hydraulic geometry: Lewis, Laurence A. 6768
Utuado batholith area, differential erosion, causes: Birot, P. 6812
Hydrogeology
Salinas area, alluvial fan of Rio Nigua: McClymonds, N. E. 7088
Weathering
Utuado batholith area, differential, causes: Birot, P. 6812
Quaternary
British Columbia
Fraser Canyon, man, fossil, sites: Borden, Charles E. 6895
California
San Pedro, Pleistocene terrace, molluscan fauna: Chace, Emery P. 7157

Quaternary
Great Lakes region
Lake Erie area, Port Talbot Interstadial, reevaluation: Dreimanis, Aleksis. 6720
Greenland
Mesters Vig, Skeldal area, glaciation, Pleistocene, retreat, chronology: Lasca, Norman Paul, Jr. 6657
North America
Man, fossil, sites, C-14 dates: Haynes, C. Vance, Jr. 6739
North Carolina
Northeastern, Mollusca, Pleistocene: Richards, Horace G. 6643
Quebec
Hebertville map-area: Lasalle, Pierre. 6693
Virginia
Southeastern, stratigraphy: Coch, Nicholas K. 6873

Quebec
Absolute age
C-14, National Physical Laboratory, list: Callow, W. J. 7014
Economic geology
Copper, Gaspe, Holland township: Brummer, J. J. 6797
Mineral resources, Montauban-Colbert map-area: Pyke, D. R. 6764
Geochemistry
Mount Vallieres-de-Saint Real map-area, prospecting, geochemical: Robert, Jean-Louis. 6694
Glacial geology
Hebertville map-area, deposits, Wisconsinan: Lasalle, Pierre. 6693
Maps
Geologic, Gaspe, Holland township, northwestern: Brummer, J. J. 6797
Geologic, Hebertville map-area, surficial: Lasalle, Pierre. 6693
Geologic, Lake Assinica map-area: Gillet, L. B. 6695
Geologic, Montauban-Colbert map-area: Pyke, D. R. 6764
Geologic, Mount Vallieres-de-Saint Real map-area: Robert, Jean-Louis. 6694
Mineralogy
Gaspeite Gaspe Peninsula, new nickel carbonate: Kohls, D. W. 7034
Petrology
Gatineau-Petie Nation interfluve, granitization stages: Dimroth, Erich. 7122
Lake Assinica map-area: Gillet, L. B. 6695
Montauban-Colbert map-area: Pyke, D. R. 6764
Stratigraphy
Cambrian-Devonian, Mount Vallieres-de-Saint Real map-area: Robert, Jean-Louis. 6694
Precambrian, Lake Assinica map-area: Gillet, L. B. 6695
Quaternary, Hebertville map-area. Lasalle, Pierre. 6693

Quebec
Structural geology
Gaspe, Holland township, synclinorium: Brummer, J. J. 6797
Gatineau-Petite Nation interfluve, deformation sages: Dimroth, Erich. 7122
Montauban-Colbert map-area: Pyke, D. R. 6764
Mount Vallieres-de-Saint Real map-area: Robert, Jean-Louis. 6694

Radioactivity
Soils
California, Sierra Nevada, uranium, thorium, distribution: Hansen, Richard Oto. 6684

Radioactivity methods
Techniques
Salt exploration, brine wells, geophysical logging: Bird, James M. 6893
Uranium exploration: Michelson, Robert A. 7158

Radioactivity surveys
Colorado
Wet Mountains, Ilse fault zone area: Singewald, Q. D. 7102

Radiolaria
Cretaceous
Alaska, northern, microfaunal zones, correlation: Bergquist, Harlan R. 6824

Radium
Analysis
Chemical methods, separation and determination procedures: Sedlet, Jacob. 6979
Properties
Chemical and physical: Sedlet, Jacob. 6979

Radon
Analysis
Chemical methods, separation and determination procedures: Sedlet, Jacob. 6979
Properties
Chemical and physical: Sedlet, Jacob. 6979

Rare earths
Geochemistry
Phosphorites, recovery potenial: Altschuler, Zalman S. 7181

Reefs
Barbados
Quaternary, coral cap terraces: Russell, R. J. 6813
Ohio
Silurian, Cayugan Series: Textoris, Daniel A. 6807

Reptilia
Mosasaurinae
Cretaceous, United States, western, skull: Russell, Dale Alan. 6661

Rivers
Channel geometry
Humid tropical basin, Puerto Rico, Rio Grande de Manati: Lewis, Laurence A. 6768

Rivers
Puerto Rico
Rio Grande de Manati, channel changes and hydraulic geometry: Lewis, Laurence A. 6768
Sediment ransport
Dominant discharge defined, relation to channel shape and meanders: Benson, M. A. 6962
Salt
Experimental studies
Solution mining, strain redistribution at surface: Emery, C. L. 6750
Spherical cavities, tri-axial compression, creep, pressure-temperature effects: Nowotny, Ben. 6748
Exploration
Acoustical logging, 3-D system: Christensen, Dean M. 6923
General
Symposium, Northern Ohio Geological Society: Rau, Jon L. 6924
Gulf Coastal Plain
Salt domes, review: Halbouty, Michael T. 6878
New Mexico
Carlsbad district, halite zones, potash ore, genesis: Linn, Kurt O. 6921
Ohio
Fairport Harbor mine, solubility of impurities, effect on produced brine: Andelfinger, George F. 6850
Properties
Impurities, solubility, effect on produced brine: Andelfinger, George F. 6850
Structural behavior, continuum theory, laboratory model, mines: Serata, Shosei. 6745
Utah
Great Salt Lake area, geochemistry, hydrogeology, environmental factors: Cohenour, Robert E. 6917
Sevier Valley, Arapien Formation, bedded halite: Pratt, A. R. 6760
Virginia
Saltville area, occurrence, Maccrady Formation: Cooper, Byron N. 6759
Salt tectonics
Louisiana
Winnfield dome, halite orientation: Schwerdtner, W. M. 6678
Mechanism
Gulf Coastal Plain, review: Halbouty, Michael T. 6878
Saskatchewan
Economic geology
Potash, carnallite problem, exploration: Hurd, Donald W. 7180
Engineering geology
Gas storage, Prairie Evaporite Formation: Allan, M. H. 6747
Paleontology
Bacteria, Devonian, rock salt, living: Dombrowski, H. J. 6918
Saskatchewan
Petrology
Esterhazy, Prairie Evaporite, fabric analysis: Clark, A. R. 6854
Sedimentary rocks
Arenites
Petrology, Colorado: Lewis, John Hubbard. 6658
Carbonate rocks
Composition, thermogravimetry, X-ray diffraction: McCaleb, Stanley B. 7125
Geochemistry, carbohydrates, Onondaga Group, N.Y.-Penn.: Swain, F. M. 6926
Petrology, Cayugan Series, Ohio: Textoris, Daniel A. 6807
Clastics
General description, Costa Rica, Coastal Range, southern: Henningsen, Dierk. 6666
Clay
Mineral composition, California, Mojave Desert, playa crusts: Langer, Arthur M. 6663
Composition
Zeolites, modes of occurrence, origin, reactions: Hay, Richard L. 6762
Evaporites
Fabric, Saskatchewan, Esterhazy, potash mines: Clark, A. R. 6854
Mineral composition, California, Mojave Desert, playa crusts: Langer, Arthur M. 6663
Limestone
Physical properties, elastic, compressional wave velocity: Wang, Chi-Yuen. 6903
Lithofacies
California, Kramer borate lake beds, Boron area: Barnard, Ralph M. 6852
Methods
Heavy minerals, separation and counting: Ramesam, V. 6971
Petrology, X-radiography of slabs: Weiss, Malcolm P. 6777
Porosity, determination, Russell-type volumeter: Grubbs, David M. 6642
Phosphate rock
Mineral composition, geochemistry, U.S., western, analyses: Gulbrandsen, R. A. 6860
Physical properties
California, Mojave Desert, playa crusts: Langer, Arthur M. 6663
Sandstone
General description, Ordovician eu- vs. miogeosynclinal quartzites, western U.S.: Ketner, Keith B. 7107
Heavy minerals, California, Stanford University area: Tieh, Thomas Ta-pin. 6664
Heavy minerals, separation and counting methods: Ramesam, V. 6971
Physical properties, aeolotropy, Potsdam formation, Ontario: Pegler, A. V. 6894
Sedimentary structures
Crossbedding
Pebble, orientation: SenGupta, Supriya. 7028

Sedimentary structures
General
California, Cretaceous series, Upper, Ventura County: Rust, B. R. 6831
California, Pico Formation, Santa Paula Creek section: Crowell, John C. 6647
Oolites
Diagenetic pyritizaion: Kalliokoski, J. 7130
Varves
Colorado, Florissant Lake beds, Oligocene. McLeroy, Carol Ann. 6829
Sedimentation
Cyclic
Evaporites, Utah, Paradox salt beds, bromine distribution: Raup, Omer B. 6761
Environment
Alluvial fan, New Mexico, Jornada del Muerto basin, southern, soil formation: Gile, L. H. 7146
Beach, semiarid, Texas, hurricane effects: Hayes, Miles Oren. 6655
Indicators, carbohydrate content, Onondaga Group, N.Y.–Penn.: Swain, F. M. 6926
Lake, saline, playa crusts, California, Mojave Desert: Langer, Arthur M. 6663
Experimental studies
Fluorescent tracers: Teleki, P. G. 7023
Ocean currents
Atlantic Ocean, Antarctic Bottom Current, Bermuda Rise: Heezen, Bruce C. 7045
Littoral drift, engineering problems, methods of determination: Johnson, J. W. 7201
Pelagic record: Arrhenius, Gustaf. 6927
Rates
Grain–shape effect: Janke, N. C. 6973
Pelagic record: Arrhenius, Gustaf. 6927
Stokes Law, grain–size effect: Schlee, John. 6970
Stream transport
Pebbles, orientation, imbrication: SenGupta, Supriya. 7028
Turbidity currents
California, Pico Formation, Santa Paula Creek: Crowell, John C. 6647
Wind transport
Pelagic record: Arrhenius, Gustaf. 6927
Sediments
Alluvium
Fabric analysis, Illinois, Ohio River, flood plain: Nunnally, Nelson Rudolph. 6682
Diatomaceous
Gulf of California, silica source: Calvert, S. E. 6913
Geochemistry
Manganese nodules, electron probe analysis: Burns, R. G. 7032
Ocean basins, record, ocean, atmosphere, outer space phenomena: Arrhenius, Gustaf. 6927
Pacific Ocean, northern, analyses, area comparisons: Palacas, James G. 7112
Methods
Fluorescent tracers, sand particle migration: Teleki, P. G. 7023
Sediments
Methods
Grain–size analysis, sedimentation tube, marine geology: Schlee, John. 6970
Sample splitter, moist or muddy samples: McManus, Dean A. 6966
Shape analysis, synthesis from particle parameters: Janke, N. C. 6973
Water extraction, hydraulic squeezer: Manheim, Frank T. 7090
Physical properties
Shape analysis, expected shapes, classification: Smalley, I. J. 6972
Shape analysis, relation to settling velocity: Janke, N. C. 6973
Provenance
Nevada, Connors Pass quadrangle, stream sediments, heavy minerals: Young, E. J. 7114
Till
Fabric analysis, stone orientaion, early theory: Elson, John A. 6811
Seismic methods
Experimental studies
California and Nevada, explosions, Pn residuals, staisical treatment: Freedman, Helen W. 7199
Instruments
Movable array: Lehner, Francis E. 6956
Seismometer, phase–sensitive parametric, construction: Rodgers, P. W. 6957
Seismometer, vertical strain, response to body waves: Gupta, Indra N. 6952
Interpretaion
Crustal studies, ray procedure, theoretical seismogram calculation, array of stations: Kane, Julius. 6954
Reflection, refraction, crustal structure, low–velocity zone: Landisman, Mark. 6742
Objects
Potash exploration, Saskatchewan: Hurd, Donald W. 7180
Reflection
Plane elastic waves from transition layers, numerical analysis: Gupta, Ravindra N. 7097
Techniques
Array filters, response, ambient noise field: Clay, C. S. 6794
Multichannel z–transforms, minimum–delay technique: Robinson, Enders A. 6774
Noise attenuation, seismograph recording in shallow holes: Douze, Eduard J. 7203
Seismograph array, movable: Lehner, Francis E. 6956
Seismic surveys
Arctic Ocean
Crustal studies, Beaufort Sea: Milne, A. R. 7093
Atlantic Ocean
Continental shelf, Nova Scotia, crust, manle structure: Keen, Charlotte. 6897
Continental shelf, Nova Scotia, refraction, crustal thickness: Berger, Jon. 7041

Seismic surveys
Nevada
Nevada Test Site, nuclear cavities and lava tunnels: Watkins, Joel S. 7052
Seismology
Elastic waves
Body waves, recording, vertical strain seismometer response: Gupta, Indra N. 6952
Compressional, velocity, limestone, marble, calcite: Wang, Chi-Yuen. 6903
Compressional waves, velocity, feldspar: Christensen, Nikolas I. 6819
Decoupling, nuclear explosions, Salmon event: Patterson, Dan W. 6725
P-head waves, attenuation, lava, ash, limestone, Arizona: deBremaecker, J. C. 6914
Plane waves, reflection from transition layers, numerical analysis: Gupta, Ravindra N. 7097
Pn residuals, statistical treatment, explosion data, California and Nevada: Freedman, Helen W. 7199
PP-waves, crustal structure analysis: Wu, Francis T. 7095
Primary, nuclear explosion, elastic source analysis: Trembly, Lynn D. 7096
P-wave, Salmon nuclear event, interpretation: Archambeau, C. B. 6711
P-waves, amplitude, first arrival, Salmon event: Springer, Donald L. 6710
P-waves, traveltimes, surface focuses: Carder, Dean S. 6953
Rayleigh wave, radiation patterns, determination, reciprocity theorem: Gupta, Indra N. 6951
Shear, velocity, metamorphic rocks: Christensen, Nikolas I. 6906
SH-point source, field, layered medium: Vlaar, M. J. 7058
Traveltimes, amplitudes, U.S., western, Salmon event: Jordan, James N. 6705
Velocity, nuclear explosions, Salmon project: Rogers, Leo A. 6726
Velocity, reversals, crust, low-velocity zone: Landisman, Mark. 6742
Velocity, reversals, crust, low-velocity zone: Mueller, Stephen. 6741
Velocity-depth function, exponential: Kaufman, H. 6743
Practice
Advances, instrumentation and information: Press, Frank. 6930
U.S. Coast and Geodetic Survey investigations, 1964 Prince William Sound earthquake: Wood, Fergus J. 7160
Shorelines
Ancient
Mississippi Valley, Embayment, Quaternary: Cooke, C. Wythe. 6793
Silurian
Ohio
Maumee area, Cayugan Series: Textoris, Daniel A. 6807
Silver
Analysis
Chemical methods, detection, separation and determination procedures: Przybylowicz, Edwin P. 6976
General
Occurrence, recovery, properties, analysis: Przybylowicz, Edwin P. 6976
Idaho
Coeur d'Alene, resources, review: Beall, John V. 7169
Isotopes
Ag-107/ Ag-109, Canyon Diablo meteorite, cf. terrestrial: Dews, Jon Robert. 6665
Nevada
Silver Peak, resources, mining: Ebbley, Norman. 7126
Properties
Metal and compounds, chemical and physical: Przybylowicz, Edwin P. 6976
Soils
Alaska
Fairbanks silt, moisture movement below 0°C: Hoekstra, Pieter. 6941
Howard Pass area, distribution, genesis, petrology: MacNamara, Edlen E. 6659
California
Sierra Nevada, uranium, thorium, distribution: Hansen, Richard Oto. 6684
Carbon-14 dating
Potential use: Dimbleby, G. W. 6732
Engineering properties
Residual shear strength, control by mineralogy, experimental tests: Kenney, T. C. 7154
Textbook: Wu, Tien Hsing. 6871
Erosion
Water repellence, wildfire temperature effects, California: Debano, L. F. 7025
Genesis
Profile development, C-14 dating: Dimbleby, G. W. 6732
Geochemistry
Gibbsite formation, experimental: Hsu, Pa Ho. 7148
Georgia
Cecil and Hayesville series, similarities: Gibbs, J. A. 7147
Haiti
Northwest peninsula, coastal plain, profiles and parent materials: Pahaut, P. E. 6936
Nebraska
Northwestern, paleosol, late Eocene: Pettyjohn, Wayne A. 7108
New Mexico
Tornada del Muerto basin, alluvial-fan deposits, periodic formation: Gile, L. H. 7146
South Dakota
Western, paleosol, late Eocene: Pettyjohn, Wayne A. 7108

South Dakota
Geomorphology
Bethlehem and Jewel Caves: Deal, Dwight E. 7056
Jewel Cave, stalagmites, mud: Deal, Dwight E. 7038
Sedimentary petrology
Bethlehem and Jewel Caves, pebbles, polished: Deal, Dwight E. 7056
Western, soil profile, late Eocene: Pettyjohn, Wayne A. 7108
Specific gravity
Measurement
Minerals, micropycnometer: May, Irving. 6975
Spectroscopy
Absorption
Atomic, trace metal analysis, quartz vein: Price, Van. 6641
Emission
Exoelectron, graphic representation, instrument, geologic significance: Lewis, D. R. 7066
Mercury in sulfide ore, technique: Dinnin, Joseph I. 7085
Trace elements in apatite, quantitative determination: Waring, Claude L. 7087
Infrared
Emission, minerals, rocks, interferometry, 20°C: Low, M. J. D. 6766
Ultraviolet
Sand, migration, fluorescent tracer technique: Teleki, P. G. 7023
X-ray fluorescence
Technique, moderate-dilution rock fusion: Czamanske, Gerald K. 6859
Springs
Nevada
White River area, discharge, regional hydrologic system: Eakin, Thomas E. 6866
Wisconsin
La Crosse area, fluctuations, climatic variables: Curtis, Willie R. 6882
Statistical methods
Economic geology
Evaluation, sample assay, area of influence: Hazen, Scott W. 7171
Trend-surface analysis, sulfur-isotope ratios: Field, Cyrus W. 7184
Geophysical surveys
Auto-analysis, cross analyses, geoid form, gravity data: Kaula, W. M. 7212
Linear regression prediction, gravity anomalies: Groten, Erwin. 7211
Point prediction, mean anomaly prediction, gravity nets, extension: Rapp, Richard. 7195
Structural geology
Trend-surface analysis, preferred alinements, Louisiana salt domes: Harvey, J. R. 6916
Stratigraphy
General
Zone, use of term: Berry, William B. N. 6776
Stromatoporoidea
Morphology
Microstructures, Paleozoic genera: Stearn, Colin W. 6885
Taxonomy
Microstructures, Paleozoic genera: Stearn, Colin W. 6885
Strontium
Abundance
Earth's crust, summary, mineralogy, isotopes: Turekian, Karl K. 7021
Analysis
Chemical methods, separation and determination procedures: Turekian, Karl K. 7021
Sulfur
Abundance
Coal: Walker, F. E. 7210
Geochemistry
Experimental studies: Craig, J. R. 6638
Experimental studies: Kullerud, G. 6637
Solubility, mafic magma: Skinner, Brian J. 6770
System Fe-Zn-S: Barton, Paul B., Jr. 7183
Gulf Coastal Plain
Salt domes, review: Halbouty, Michael T. 6878
Isotopes
Ratios, Utah, Bingham: Field, Cyrus W. 7184
Tectonics
General
Forces, vertical shear component of stress, overburden weight: Howard, J. H. 6790
Relation to plutonism, United States, western: Ramspott, L. D. 6792
Gravity sliding
Mechanism, gypsum dehydration: Heard, Hugh C. 7065
North America
Cratonic sequences, orogeny and epeirogeny, geographic patterns: Sloss, L. L. 6937
Recent deformation
California, Cholame Valley region, San Andreas fault system: Dickinson, William R. 7063
Canada, Arctic Archipelago: Pelletier, B. R. 7040
Vertical tectonics
Pacific Ocean crust, Hawaii area: Moberly, R., Jr. 6943
Puerto Rico Trench, Mid-Atlantic Rise, gravity anomalies, viscous model: Morgan, W. Jason. 6908
Puerto Rico Trench, Mid-Atlantic Rise, gravity anomalies, viscous model: Talwani, Manik. 6714
Tektites
Composition
Major elements, Georgia: King, Elbert A., Jr. 6890
Tennessee
Economic geology
Phosphate, Ocoee Series, Sevier County: Wedow, Helmuth. 7129

Tennessee
Geochemistry
Lead isotopes: Heyl, A. V. 7121
Paleontology
Algae, Cambrian, Copper Ridge Dolomite, Union and Claiborne Counties: Harris, Leonard D. 7106
Sedimentary petrology
Union and Claiborne Counties, Copper Ridge Dolomite, stromatolitic structure: Harris, Leonard D. 7106
Stratigraphy
Cambrian–Ordovician, Dumplin Valley, fault zone: Hatcher, Robert Dean, Jr. 6685
Mississippian, Upper, Beans Creek area, map construction methods: Ferguson, C. C. 6984
Structural geology
Eastern, Dumplin Valley, fault zone, origin: Hatcher, Robert Dean, Jr. 6685
Tertiary
Alaska
Cook Inlet region, floral correlation, time-stratigraphic units: Wolfe, Jack A. 6911
California
Boron area, Kramer lake beds, Miocene: Barnard, Ralph M. 6852
Calico Mountains, Arthropoda, Barstow Formation, nodules: McLaughlin, R. B. 6844
Nomenclature, Kramer beds, Boron area, Miocene, Shale Member: Barnard, Ralph M. 6852
Santa Paula Creek, Pico Formation: Crowell, John C. 6647
Colorado
Central, Florissant Lake deposits, Oligocene: McLeroy, Carol Ann. 6829
General
Oligocene, Miocene, boundary problem: Wheeler, Harry E. 6795
Nebraska
Pliocene, Aves, stork, n. gen. n. sp.: Short, Lester L., Jr. 7145
Oregon
Canyon City quadrangle, Columbia River Group and Mascall Formation: Thayer, T. P. 7110
Texas
Bastrop County, Wilcox Group, Rockdale Formation, revision: Sharp, W. W., Jr. 6809
Utah
Markagunt Plateau, northern, stratigraphy, structural evolution: Anderson, John Jerome. 6683
Virginia
Southeastern, Pliocene stratigraphy: Coch, Nicholas K. 6873
West Indies
Lesser Antilles, Ostracoda, Antigua Formation, Oligocene: Bold, W. A. van den. 7027
Wyoming
Southwestern, Green River Formation, trona beds, paleolimnology: Bradley, W. H. 6679

Texas
Absolute age
Atascosa County, water, Carrizo Sand, carbonate, C-14: Pearson, F. J., Jr. 6737
C-14, Instituto Venezolano Inv. Cientificas laboratory, list: Tamers, M. A. 7011
C-14, Texas Univ. laboratory, list: Pearson, F. J., Jr. 7017
Economic geology
Evaporites, geochemistry: Adams, Samuel S. 7179
Geochemistry
Delaware basin, evaporites, bromide profiles, halite: Holser, William T. 6920
Llano Uplift, whole rock, mineral, lead isotope ratios: Ulrych, T. J. 6818
Geomorphology
Coastal area, beaches, hurricane effects: Hayes, Miles Oren. 6655
Hydrogeology
High Plains, southern, water-level data: Gammon, Sam W. 6782
Maps
Geologic, Texarkana sheet: Texas University Bur. Econ. Geology. 6674
Paleontology
Brachiopoda, Pennsylvanian, central, spiriferid: Branson, Carl C. 6935
Crinoidea, Permian, Word Formation, Glass Mts., n. gen.: Strimple, Harrell L. 6840
Gymnosperms, Permian, Lueders Limestone, pteridosperms: Mamay, Sergius H. 6677
Sedimentary petrology
Coastal area, beach, dune, hurricane effects: Hayes, Miles Oren. 6655
Stratigraphy
Cretaceous, Austin Group, northeastern: Lokke, Donald H. 6912
Tertiary, Wilcox Group, Rockdale Formation, revised, Bastrop County: Sharp, W. W., Jr. 6809
Thermodynamic properties
Activity
FeS, system Fe-Zn-S: Barton, Paul B., Jr. 7183
Iron, manganese: Bartholome, Paul. 7185
Oxygen, Fe-Ti oxides: Lindsley, D. H. 6652
Fugacity
Oxygen, chromite: Ulmer, Gene C. 6650
Oxygen, Muskox intrusion: Irvine, T. N. 6649
Sulfur, system Fe-Zn-S: Barton, Paul B., Jr. 7183
Tin
Alaska
Cape Creek, submarine drilling, problems: Howard, Thomas E. 7168
Canada
Occurrence, distribution: Mulligan, Robert. 6799
Titanium
Geochemidstry
Muskox intrusion: Irvine, T. N. 6649
United States
Resources, occurrence: Peterson, Edward C. 7193

Trace elements
Geochemistry
Sandstone and uranium ore, distribution, Wyoming: Harshman, E. N. 7081
Sea water: Siegel, A. 6858
Trace-element analyses
Apatite
Emission spectroscopy, technique: Waring, Claude L. 7087
Ontario, Faraday township, carbonate-bearing: Gulbrandsen, R. A. 7035
Coal
Sulfur content: Walker, F. E. 7210
Granite
Colorado, Redskin and Pikes Peak Granites: Hawley, C. C. 7119
Natural gas
United States 1964, helium content: Moore, B. J. 7192
Norite
Ontario, Sudbury: Souch, B. E. 6773
Phosphate rock
U.S., western, Phosphoria Formation: Gulbrandsen, R. A. 6860
Quartz, vein
Metal content, atomic absorption spectrophotometry: Price, Van. 6641
Sandstone
Wyoming: Harshman, E. N. 7081
Schist
California, Sónoma County, Franciscan Formation member: Lee, Donald E. 7120
Uranium ore
Wyoming: Harshman, E. N. 7081
Trilobita
Cambrian
New York, Taconic sequence, new faunule: Rasetti, Franco. 7132
Ordovician
Yukon, northern, Road River Formation: Lenz, A. C. 6879
Robergia yukonensis n. sp.
Ordovician, Yukon, northern, Road River Formation: Lenz, A. C. 6879
Tsunami
Power spectrums
Hawaiian and Midway staions, digital computation, time changes between staions: Loomis, Harold G. 7198
Unconformities
North America
Cratonic sequences, tectonism, orogeny and epeirogeny: Sloss, L. L. 6937
Oklahoma
Carboniferous: Beckman, W. A., Jr. 6805
United States
Absolute age
C-14, archeological, Great Plains: Neuman, Robert W. 6756
C-14, Arizona Univ. Geochronology Laboratories, list: Haynes, C. Vance, Jr. 6985
United States
Absolute age
C-14, eastern, sites, archeological: Griffin, James B. 6755
C-14, Isotopes, Inc. laboratory, list: Trautman, Milton A. 6992
C-14, Smithsonian Inst. laboratory, list: Long, Austin. 6944
C-14, UCLA laboratory, western, list: Berger, Rainer. 6942
C-14, Wisconsin Univ. laboratory, list: Bender, Margaret M. 7009
Economic geology
Coal, sulfur analyses: Walker, F. E. 7210
Natural gas, helium content: Moore, B. J. 7192
Phosphate, eastern, production: Cathcart, James B. 7177
Titanium, resources, occurrence: Peterson, Edward C. 7193
Engineering geology
Activities 1965: Proctor, Paul D. 7189
General
Geological exploration, activities 1965: Patrick, Joseph L. 7190
Geochemistry
General, geochemical prospecting 1965: Bloom, Harold. 7188
Western, Great Basin, saline waters, evolution: Jones, Blair F. 6669
Western, Phosphoria Formation, analyses: Gulbrandsen, R. A. 6860
Geomorphology
Streams, eastern and southwestern, dominant discharge, defined: Benson, M. A. 6962
Geophysical surveys
Activities in 1965: Heinrichs, Walter E., Jr. 7187
Western, seismic, Salmon nuclear event, mantle velocity: Jordan, James N. 6705
Hydrogeology
Streams, eastern and southwestern, dominant discharge, defined: Benson, M. A. 6962
Western, Great Basin, saline waters, evolution: Jones, Blair F. 6669
Paleontology
Foraminifera, Pennsylvanian, southwestern, *Fusulina*: Elias, Maxim K. 6839
Reptilia, Cretaceous, western, mosasaur: Russell, Dale Alan. 6661
Sedimentary petrology
Western, Ordovician quartzites, eugeosynclinal vs. miogeosynclinal: Ketner, Keith B. 7107
Structural geology
Western, crust, mantle, seismic data, Salmon nuclear event: Archambeau, C. B. 6711
Volcanology
Calderas, conference, with Japan: Blank, H. Richard, Jr. 6708
Uplifts
Colorado
Uncompahgre, age: Cater, Fred W. 7111

Uranium
Exploration
Techniques, review: Michelson, Robert A. 7158
Genesis
Sedimentary beds, review: Michelson, Robert A. 7158
Geochemistry
Ore guides, roll-type deposit, Wyoming: King, J. W. 7186
Greenland
Ilimaussaq intrusion, occurrence: Sorensen, Henning. 6645
Isotopes
Ratios, natural variation, Pleistocene, dating potential: Thurber, David Lawerence. 6769
Wyoming
Gas Hills, roll-type, ore guides: King, J. W. 7186
Shirley basin, geochemistry and genesis: Harshman, E. N. 7081

Utah
Absolute age
Granitic rocks, K-Ar, synchronous plutonic and volcanic: Armstrong, Richard Lee. 6889
Southwestern, denudation rate, C-14: Eardley, A. J. 6959
Economic geology
Beryllium, western: Shawe, D. R. 7084
Brines, Paradox basin, possibilities: Mayhew, E. J. 6919
Metals, Stockton district, zonal distribution: Moore, William J. 7083
Salt, Great Salt Lake, environmental factors: Cohenour, Robert E. 6917
Salt, Sevier Valley, Arapien Formation, bedded halite: Pratt, A. R. 6760
Geochemistry
Bingham, sulfur isotopes: Field, Cyrus W. 7184
Germanium in willemite: Scheffer, Herman W. 6861
Moab region, Hermosa Formation, Paradox salt beds, bromine: Raup, Omer B. 6761
Geomorphology
Erosion, denudation rates, southwestern: Eardley, A. J. 6959
Great Salt Lake, fluctuation, saline deposits, environmental factors: Cohenour, Robert E. 6917
Markagunt Plateau, northern, fault blocks: Anderson, John Jerome. 6683
Geophysical surveys
Uncompahgre Plateau, gravity, magnetic, anomalies, correlation with geology: Case, James E. 6780
Hydrogeology
Great Salt Lake, fluctuation, saline deposits, environmental factors: Cohenour, Robert E. 6917
Mineralogy
Clay minerals, mica-type, Willard Reservoir: Guven, Necip. 7005

Utah
Mineralogy
Coconinoite, Jomac mine, new: Young, E. J. 6939
Willemite, Ge content: Scheffer, Herman W. 6861
Stratigraphy
Pennsylvanian, Hermosa Formation, Paradox Member, halite units: Raup, Omer B. 6761
Precambrian, subdivision, Uncompahgre Plateau, geophysical data: Case, James E. 6780
Tertiary, Markagunt Plateau, northern, evolution: Anderson, John Jerome. 6683
Structural geology
Markagunt Plateau, northern, fault blocks: Anderson, John Jerome. 6683
Weathering
Willard Reservoir, clay minerals: Guven, Necip. 7005

Vermont
Hydrogeology
Batten Kill, Walloomsac River, Hoosic River basins, ground water: Hodges, Arthur L., Jr. 6648
Maps
Ground water, Baten Kill, Walloomsac River, Hoosic River basins: Hodges, Arthur L., Jr. 6648
Paleomagnetism
Mesozoic, White Mountains, magma series: Opdyke, N. D. 6815

Virginia
Areal geology
Southeastern, field trip: Coch, Nicholas K. 6873
Economic geology
Salt and gypsum, Saltville area, Greendale syncline: Cooper, Byron N. 6759
Geophysical surveys
Leesburg area, Triassic diabase, magnetic, anomaly due to lightning: Toewe, E. Clayton. 6832
Maps
Geologic, southeastern, inner Coastal Plain: Coch, Nicholas K. 6873
Petrology
Albemarle County, Fluvanna County, metasediments, phyllites, paragonite-bearing: Milici, R. C. 6639
Stratigraphy
Cambrian-Mississippian, Saltville area, Greendale syncline, salt, gypsum: Cooper, Byron N. 6759
Cenozoic, post-Miocene, southeastern, field trip: Coch, Nicholas K. 6873
Paleozoic(?), phyllite, paragonite-bearing, cf. Candler Formation, central: Milici, R. C. 6639
Structural geology
Saltville area, Greendale syncline, overthrusting: Cooper, Byron N. 6759

Volcanism
Calderas
United States, Japan, conference: Blank, H. Richard, Jr. 6708

Volcanoes
Guatemala
Central, Highlands chain and lava plateau, geomorphology, relief map: Weyl, Richard. 7068
Mexico
Paricutin, 1965: Segerstrom, Kenneth. 7113
Revillagigedo archipelago, Isla San Benedicto and submarine ridges: Richards, Adrian F. 7134

Washington
Absolute age
C-14, Univ. Washington laboratory, list: Fairhall, A. W. 7007

Weathering
Clay minerals
Utah, Willard Reservoir, mica-type: Guven, Necip. 7005
Jamaica
Above Rocks batholith area, differential, causes: Birot, P. 6812
Products
Construction materials, soil: Keller, W. D. 6691
Puerto Rico
Utuado batholith area, differential, causes: Birot, P. 6812

Well logging
Acoustical
3-D system, rock salt, elastic properties in-situ: Christensen, Dean M. 6923
Electrical
Methods, brine wells, application, interpretation: Bird, James M. 6893
Methods, evaporite exploration: Alger, R. P. 6848
Water wells, applications: Carter, V. B. 7225
Radioactivity
Methods, brine wells, application, interpretation: Bird, James M. 6893

Wells and drill holes
British Columbia
Fraser Valley, Aldergrove test hole, hydrology, unconsolidated deposits: Halstead, E. C. 6800
Massachusetts
Housatonic River basin, Berkshire County, water wells: Norvitch, Ralph F. 6827
Vermont
Batten Kill, Walloomsac River, Hoosic River basins, water wells and test borings: Hodges, Arthur L., Jr. 6648

West Indies
Absolute age
Aruba, quartz-diorite batholith: Priem, H. N. A. 7204
Paleontology
Ostracoda, Oligocene, Antigua Formation, Lesser Antilles: Bold, W. A. van den. 7027

West Indies
Volcanology
Magmatic products, Cretaceous-Recent, crust source, questioned: Weyl, Richard. 6767

Wisconsin
Absolute age
C-14, Victoria Institute of Applied Science, Two Creeks area: Bermingham, Anne. 7008
Hydrogeology
La Crosse area, spring flow, response to climatic variables: Curtis, Willie R. 6882
Maps
Aeromagnetic, Wakefield (Mich.) quadrangle: Philbin, P. W. 6697

Wyoming
Economic geology
Evaporites, southwestern, Green River Formation, trona beds, genesis: Bradley, W. H. 6679
Uranium, roll-type, Gas Hills, ore guides: King, J. W. 7186
Uranium, Shirley basin, geochemistry and genesis: Harshman, E. N. 7081
Geochemistry
Shirley basin, trace-element distribution, sandstone and uranium ore: Harshman, E. N. 7081
Geomorphology
Teton Mountains, South Darby Canyon, karst features: Stellmack, John A. 7053
Geophysical surveys
Wind River Basin, gravity: Case, J. E. 7116
Wind River Mountains, gravity: Berg, Robert E. 6789
Mineralogy
Al-bentonites: Brydon, J. E. 7006
Ferroselite, Powder River basin, uranium ore body: Granger, H. C. 7118
Paleontology
Ostracoda, Jurassic, Morrison Formation, *Theriosynoecum* type: Branson, Carl C. 6838
Stratigraphy
Tertiary, Green River Formation, Wilkins Peak Member, trona beds: Bradley, W. H. 6679
Structural geology
Wind River Basin, gravity data: Case, J. E. 7116
Wind River Mountains, faults: Berg, Robert E. 6789

X-ray diffraction analysis
Data
Alluaudite: Fisher, D. Jerome. 7018
Analcite: Peters, Tj. 6997
Ca-phillipsite, wairakite, synthetic Ca- and Sr-analcime: Ames, L. L., Jr. 7033
Chabazite, silica rich, California: Gude, Arthur J., 3d. 6987
Coconinoite, Arizona and Utah, new mineral: Young, E. J. 6939
Epididymite, Greenland, Narssarssuk and Ilimaussaq: Petersen, Ole V. 7000
Gaspeite, new nickel carbonate: Kohls, D. W. 7034